1771
XLII

FLIGHT

1/-

and
The AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

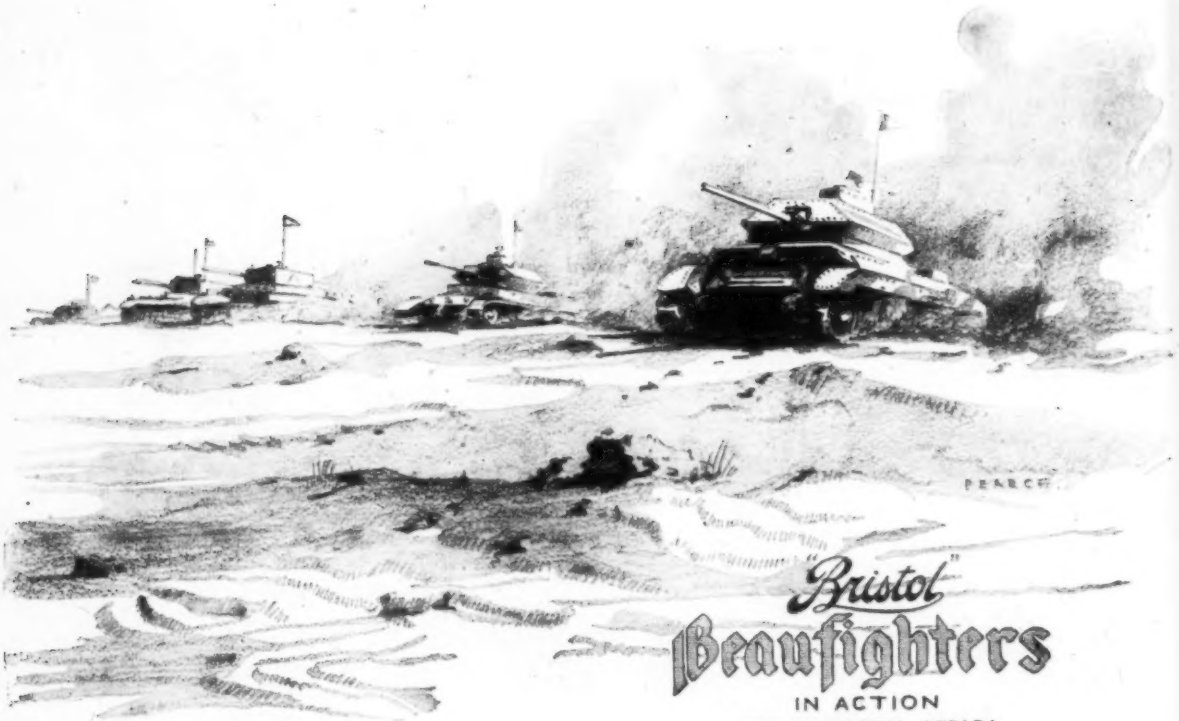
DECEMBER 3rd, 1942

Precise measures are being taken

Simmonds

FREE-FLOAT

CONTENTS GAUGE



"Bristol" Beaufighters
IN ACTION
OVER NORTH AFRICA.

THE BRISTOL AEROPLANE COMPANY LIMITED.

FLIGHT and The AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

Editor
C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH, M.B.E.

Chief Photographer
JOHN YOXALL

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The Outlook

"Nearly 50,000ft."

CONSIDERABLE astonishment has been caused (not least, one may assume, to the German *Luftwaffe*) by the feat of three British pilots in bringing down three of the new German Junkers Ju 86 high-altitude machines over the Egyptian area. The official account of the achievement, which was released too late for us to record it in last week's issue, related how first one British pilot on a Spitfire brought down one of the Ju 86s, then how two others between them downed a second, and how, finally, the first pilot brought down a third, *his* second. The story is given elsewhere in this issue.

To appreciate fully what this blow to the *Luftwaffe* means, it is necessary to recall that the Junkers Ju 88 is fitted with a pressure cabin for the crew, whereas the Spitfire pilots, judging from the official account, did not even wear pressure suits of the type used by the two R.A.F. pilots who, some years ago, successively raised the world's altitude record in a Bristol monoplane especially designed for record purposes.

In this connection it is not without interest to recall that over ten years ago, on September 16th, 1932, to be exact, Capt. Cyril Uwins, Bristol's chief test pilot, established a world's record by flying a Vickers Vespa biplane fitted with Bristol Pegasus engine to an officially checked height of 44,000ft., or much the same altitude as that at which these three pilots made contact with the German machines recently. Uwins wore electrically heated clothing and, of course, oxygen equipment, but no pressure suit. Afterwards he did not report undue discomfort, but it should be remembered that he was not called upon to fight an enemy, nor did he have even to worry much about his course. Height, and still more height, was his one concern.

The Spitfire pilots, on the other hand, were flying aircraft not designed for altitude record purposes. What their armament was we have not been told, but at least it was equal to the task of bringing the enemy down. It may be assumed that the machines had been lightened in every way possible, and that such weighty items as armour protection were left behind. Nevertheless, the Spitfires must have had a much greater wing loading than had the Vespa biplane, and certainly a greater span loading, although their power loading was probably a good deal lower.

Some time ago it was announced officially that an "improved version" of the Spitfire has a Merlin 61 engine with two-stage supercharger, driving a four-bladed airscrew. It is logical to assume that the machines concerned in the Egyptian success were of this or similar type, perhaps an "improved, improved version." The combination of two-stage blower and four-bladed airscrew would appear to be rather essential for getting a Spitfire to "nearly 50,000ft."

The pilots concerned deserve every praise for their courage and determination, and, from the technical aspect, the Vickers-Supermarine and the Rolls-Royce firms may well be proud of having been associated with such a remarkable enterprise. The enemy, on the other hand, has had proof that his high-altitude reconnaissance machines are not immune from attack by our fighters. It is now up to us to see that in future our pilots will not be called upon to face the rigours of such heights without appropriate altitude equipment.

Sir Arthur Coningham Speaks Out

IN previous wars and in the present one there have been many cases of victorious British commanders speaking with admiration of the way their defeated opponents have fought. Only the other day General Montgomery entertained to dinner the German commander who had been made a prisoner-of-war, and he would hardly have done that unless he had felt that his cap-

tured opponent was a soldier to be respected. To give credit to a worthy antagonist is a characteristic of the British race. When a high British officer speaks with withering contempt of the force which he has defeated he must be feeling very strongly on the subject.

That was the tone in which Air Vice-Marshal Sir Arthur Coningham (whose recent promotion to Knight Commander of the Bath has been very well and truly earned) spoke of the *Luftwaffe* in the recent Battle of Egypt. The manner in which the famous Kesselring's pilots had abandoned their ground forces and left them to be pounded by our airmen was, he declared, "quite disgraceful."

The German Air Force in Libya, Sir Arthur also said, had suffered the most complete defeat that any air force had ever known; and, though he warned his hearers that the *Luftwaffe* as a whole was still extremely large and powerful, he gave it as an assured opinion that the North African front could only be reinforced by withdrawing aircraft from other fronts—if the Germans decided that that front was important enough.

R.A.F. Changes

CHANGES in the Higher Commands of the R.A.F. are not usually frequent, so that when they do occur there is likely to be a tendency to examine them somewhat critically for possible causes. The three Commands affected by the changes announced in this issue, Middle East, Fighter and Coastal, have all been extremely successful, each in its own particular sphere. It is an old saying that a change of work is as good as a rest, and one does not have to know very much about the inner workings of our different Commands to realise that the strain on the A.O.C.-in-C.s must have been very severe.

While there are always those who lament the changing of horses in mid-stream, it may well be that the fresh outlook brought to each Command by its new chief, and the experience which he has had of a different branch of the R.A.F., will have a beneficial effect, the more so as co-operation and combined action are coming into ever-extending use. The ability to "see the other man's point of view" should make for increased smoothness and efficiency.

There will be general disappointment in the R.A.F. (and in the country, for the matter of that, for he is known to all from his outstanding broadcasts) with the announcement that Air Chief Marshal Sir Philip Joubert is leaving Coastal Command. He is the oldest of the officers concerned in the changes, but those who have the privilege of knowing him are aware that his 55 years sit very lightly on him, and that his is a brain more than ordinarily alert. Coastal Command, working for the Admiralty, has done magnificent work, though less spectacular than that of Bomber and Fighter Commands, and his appointment to Inspector-General of the R.A.F. is the one which is least comprehensible.

CONTENTS

The Outlook	595
War in the Air	597
American Mission	600
Here and There	602
German Radials	603
Behind the Lines	607
The Air Freighters	608
Correspondence	609
Reducing to Produce	610
Spitfires above 40,000ft.	612
Whither Next ?	613
Aircraft Noise	615
Service Aviation	617

NEW CHIEFS AT M.A.P.: Sir Stafford Cripps (right), the new Minister of Aircraft Production, in conference with Air Chief Marshal Sir Wilfred Freeman, who is Chief Executive Officer at M.A.P.

WAR IN THE AIR

A Week of Good News : Grand Advance by the Russians : Luftwaffe Withdrawn to the Mediterranean : Japanese Plight in New Guinea

The Commander (Flying)—Cdr. E. O. F. Price—gives the take-off signal from the control position on an aircraft carrier's 'island.'

IN the days when Clive won the battle of Plassey and Wolfe took Quebec, someone (was it Horace Walpole?) wrote that one had to get up early to read the newspapers in case one should miss the account of some victory. The early winter of 1942 is much the same. From every front comes good news. The Russians have followed up their victory in the Caucasus with a triumphant offensive both north and south of Stalingrad, and the question is not whether Hitler's promise to capture the ruined city will be fulfilled but whether the German forces which have been attacking the city will be able to escape capture or annihilation. In New Guinea the Australian and American infantry have pressed hard on the Japanese at the landing places of Gona and Buna (which may well fall before these words are published), the Americans continue to advance round Guadalcanal, General Alexander and his Eighth Army capture place after place in Libya and press hard on the heels of Rommel's depleted columns, while in North-West Africa the race for mastery of Tunisia holds out promise of another great success by the United Nations. The vast territories of French West Africa have at last decided to join in the struggle against the Axis. In Burma the increasingly industrious bombing by R.A.F. and American squadrons of airfields held by the Japanese seems to foreshadow some move by General Wavell. The cold weather is now in full swing and that means good conditions for campaigning. The reopening of the Burma road into Yunnan would be a fitting round-off to all the other good news.

THE LAST SPIN: A Japanese bomber falling in flames over Guadalcanal.

It is rather remarkable that in the first week of the Russian counter-offensive very little mention was made of the part played by aircraft. One day there was a remark that the lifting of mist had enabled the Russian squadrons to take to the air, but that only applied to one sector of the vast front. On the same day the Germans spoke of wave after wave of German and Rumanian bombers attacking to the south-west of Stalingrad in attempts to hold back the advancing Russians. Before the war Rumania was hardly counted as one of the formidable air powers. No doubt the Germans have supplied their friends with aircraft, and likewise it is almost certain that when the Germans retreat they will throw in whatever feudatories are most handy to act as a rear-guard, just as they left Italian divisions to be mopped up by the British in Egypt. Chivalry does not enter into the German conception of war, and no doubt it is prudent for a General to extricate his most valuable troops; but such methods hardly win loyal allegiance from the victims who have been sacrificed.

The Case of Japan

IT has been mentioned before in these notes that the Japanese had sent all their aircraft away from New Guinea to the Solomons. In consequence, the Australians and Americans have not been worried from overhead as they closed in round Buna and Gona. That gave them a great advantage, for their own aircraft have been bombing and shooting up the contracting lines of the Japanese. Naturally, as the bodies of the enemy drew closer together they offered better targets to attack from the air.

Not very long ago the Japanese had plenty of aircraft for all their numerous fronts, and plenty of carriers to transport them about. They were not economical in the use of either, but expended them freely, and their losses have been proportionately heavy. Japanese staff officers have accompanied the German armies in most of their campaigns, and have carefully studied German methods, often applying them to their own purposes. No doubt they marked how in the invasion of Crete the Germans gained a rapid success by a reckless extravagance, pouring in aircraft and air-borne troops with an utter disregard of losses. This example may well have inspired the Japanese to use their carriers and aircraft with a similar disregard of losses. These losses in both categories have been very heavy, and Nippon's ability to turn out new machines or ships is not at all comparable with that of Germany, let alone that of the Allies. Now the Japanese are manifestly

WAR IN THE AIR

short, and their infantry has had to suffer in consequence.

At the same time the Japanese have been losing aircraft in Burma, not, perhaps, at a very great rate, but still with regularity. These can be replaced by land routes, without risking carriers in the Indian Ocean, where it has been stated that the Royal Navy now has a useful fleet based on Ceylon. But the losses from the operations of Allied bombers in India all tell on Japanese production.

The American bombers in China have also been busy. It is not claimed that they have put large numbers of enemy aircraft out of commission, and one does not picture the Japanese air bases there as in any way resembling the salvage heaps which the Eighth Army found on many of the Libyan airfields. But every little helps, and every Japanese bomber blown to pieces in China may well mean saving the lives of many Chinese civilians or soldiers.

As the retreating Germans approached the strong position at Agheila the weather caused a reduction of R.A.F. activity for a few days, but it did not hold up the ground pursuit of Rommel's men. Malta naturally enjoyed almost complete rest from air raids, and its fighters were able to prevent tentative raiders from crossing the coast.

German air-borne troops have been arriving in southern Tunisia as well as at Bizerta and Tunis. French forces have sometimes attacked them, but the situation there is confused. It may be that Rommel hopes to retreat across Tripolitania into Tunis, but, as was said before, we must wait and see. If all the French troops in North West Africa would come in openly on the side of the United Nations, as seems quite a likelihood, the Axis forces, even adding Rommel's remnants on to those which have been ferried across in such a hurry from Sicily and Italy, would be heavily outnumbered. In the coming clash for Tunisia air superiority must count for a great deal. The complete cessation of even tip-and-run raids on Great Britain, and the evident reduction of German air efforts in Russia, tell their own story of how wings and groups of the *Luftwaffe* have been scraped together from here and there to meet the new serious threat in the Mediterranean. Most clearly the Allied offensive there has eased the strain on the Russian armies, and so has contributed to the great advance which they have been making. The *Luftwaffe* is now stretched quite beyond all comfortable limits. Nevertheless, some stiff air fighting in North Africa is to be expected by the Royal Air Force squadrons covering either the First or the Eighth Army areas.

NORTH AFRICAN CAMPAIGN: Five German Ju 52 troop-carriers and the wreckage of an Italian S.M.81 on Tunis airfield. The S.M.81 was destroyed by a Beaufighter attack.

AN OFFICERS' MESS: Two pilots of a Spitfire squadron in North Africa trying to satisfy the inner man on Maison Blanche airfield shortly after it was captured.

New Things from Africa

THE decision of the French authorities at Dakar to bring all the huge territories of French West Africa into line with those of Morocco and Algeria in opposing the Axis relieves the United Nations of a great anxiety. Dakar itself might have been a most dangerous base for Axis aircraft and submarines if the Axis authorities had been able to get hold of it. Presumably by now the damage done to the battleship *Richelieu* by British depth charges exploded under her screws and by torpedoes launched from Swordfish has been repaired. She need no longer be regarded as a potential menace to those who are fighting for the freedom of France and of all other enslaved nations. Admiral Cunningham has expressed his belief that soon the French warships in Alexandria would declare for the United Nations, and if they do there would be every reason to expect the *Richelieu* to follow suit. French naval help would do a great deal to ease the present strain on the British and American Navies.

As the British First Army advanced into Tunisia it received very active help from American and British aircraft. Recently there was a stiff fight on the railway 30 miles south-west of Tunis, when the British tanks were helped by bombers. American bombers continued to raid airfields round Tunis and Bizerta, and they invariably destroyed enemy aircraft on the ground.

Tripoli has been a regular target for the heavy bombers with the Eighth Army and from Malta. It is now the only port through which Rommel can get supplies, and there are specula-

WAR IN THE AIR

ENEMY AIR LOSSES TO NOV. 28th

	Over G.B.	Over Continent	Middle East
Nov. 22	0	0	6
" 23	0	1	3
" 24	0	0	2
" 25	0	0	0
" 26	0	4	1
" 27	1	0	3
" 28	0	1	3
	1	6	18

Totals: West, 6,490; Middle East and French Africa, over 5,042.

FELO DE SE: A self-destroyed Ju 87D in Cyrenaica. The Germans were in such a hurry to retreat that in many cases the only destruction carried out was to start the engines and tip the aircraft on their noses.

tions as to whether he may intend to use it as a sort of Dunkerque for evacuating his forces. It would seem a desperate expedient, for assuredly the Axis cannot count on fighter superiority there as the British could during the Dunkerque episode, and without that the transports would lie at the mercy of British bombers, to say nothing of British naval strength. However, it is a long way from El Agheila to Tripoli by land, and we must await developments. In Cyrenaica the power of the *Luftwaffe* has been completely wiped out, as Air Vice-Marshal Sir Arthur Coningham has emphasised, and he added that in the face of determined resistance and attack the German cracked. This criticism cannot fairly be applied to German infantry, who have often put up a desperate resistance when things were going badly for them, but it is the experience of the R.A.F. in Cyrenaica when dealing with a battered contingent of the much-vaunted *Luftwaffe*.

Stuttgart Raided

AMONG recent bombing attacks on German war industries was the raid on Stuttgart by "a strong force," which included several squadrons of Stirlings, not one of which was lost. Drifting cloud over the target somewhat hampered visibility, but snow on the hills around the town was brilliantly lit by the many fires started. In addition to high-explosive bombs, the Stirlings alone dropped 30 tons of incendiaries, and one squadron commander, who came down low to obtain material for a report on the results of the raid, said he saw many large buildings well on fire.

For a German target, Stuttgart was not very heavily defended, with not much heavy anti-aircraft fire and only a few searchlights. But night fighters were up, taking advantage of the moonlight, both over the target and elsewhere along the route.

Extensive and highly specialised engineering works make Stuttgart a most important centre of German war industry. It is of particular importance to the submarine building yards, because of the large number of engine components produced there.

A particularly gratifying aspect of the air war during the past few weeks is the very small proportion of losses sustained by the R.A.F. Time and time again one has heard the welcome phrase, "All our aircraft returned safely," or, alternatively, "From these and other operations not one of our aircraft is missing," while even when complete survival of all our raiders could not be recorded, the numbers which have failed to return from various operations in Europe and the Middle East have mostly been expressed in small single figures.

BRITISH & U.S. AIR LOSSES TO NOV. 28th

	Over G.B.	Over Continent		Middle East
	A'crft.	B'brs.	F'trs.	A'crft.
Nov. 22	0	10	0	1
" 23	0	0	0	2
" 24	0	0	0	1
" 25	0	2	1	2
" 26	0	0	2	0
" 27	0	0	1	4
" 28	0	1	4	2
	0	13	8	12

Totals: West, 4,881; Middle East and French Africa, about 1,954.

There was, for example, a sucession of bombing attacks against war factories in Northern Italy, most of which earned for the Chief of Bomber Command the traditional pair of white gloves; large forces have also attacked such African targets as the Axis landing-ground at Marble Arch, west of El Agheila, and the Tunis docks, with their petrol dumps, oil tanks, marshalling yards and warehouses, and enemy ships in the harbours of Homs and Tripolis without the loss of a single Allied aircraft.

Over the Mediterranean, long-range fighters have been taking regular toll of Axis aircraft, especially transport machines, including a number of Junkers Ju 52s laden with troops intended to reinforce the Tunisia defences, while the shooting down of a giant six-engined Blohm and Voss Bv 222 flying boat, and several "stratosphere" Ju 86s bagged by Spitfires at altitudes of more than 40,000ft., have been, literally, highlights in the Middle East news.

R.A.F. HIGHER COMMAND CHANGES

Coastal and Fighter Commands Affected, but Not Bomber Command

ON November 17th the Air Ministry announced the following changes in the higher appointments of the Royal Air Force:—

Air Chief Marshal Sir Arthur W. Tedder, G.C.B., to be Vice-Chief of the Air Staff.

Air Chief Marshal Sir W. Sholto Douglas, K.C.B., M.C., D.F.C., to be Air Officer Commanding-in-Chief, R.A.F., Middle East.

Air Marshal T. W. Leigh-Mallory, C.B., D.S.O., to be Air Officer Commanding-in-Chief, Fighter Command.

Air Chief Marshal Sir Philip B. Joubert de la Ferté, K.C.B., C.M.G., D.S.O., to be an Inspector-General of the Royal Air Force.

Air Vice-Marshal J. C. Slessor, C.B., D.S.O., M.C., to be Air Officer Commanding-in-Chief, Coastal Command, and promoted Acting Air Marshal.

Air Vice-Marshal C. E. H. Medhurst, C.B., O.B.E., M.C., to be Assistant Chief of the Air Staff (Policy).

These changes will be effected at convenient dates in the near future.

Comments on these appointments will be found on p. 596.

AMERICAN MISSION

U.S. Aircraft Makers Praise Our Wartime Industry

IN return for a visit of a British Air Mission to the United States, under the leadership of Mr. Alexander Dunbar, Controller-General of the Ministry of Aircraft Production, a group of representatives of the American aircraft industry has recently, as already recorded in *Flight*, spent a fortnight seeing some of our own aircraft, engine and airscrew plants. They were led by Mr. T. P. Wright, Deputy-Director of Aircraft Production in the U.S. War Production Board, who, as vice-president (engineering) of the Curtiss Wright Corporation, was already well-known to many people here, and included such outstanding personalities as Mr. P. G. Johnson, president of the Boeing Company; Mr. Ken Ebel, vice-president and chief engineer of Glenn Martin; Mr. I. M. Laddon, vice-president of Consolidated; Mr. J. Carlton Ward, Jnr., president of Fairchild and its subsidiary, the Ranger Engineering Corp.; Mr. "Don" Welty, general manager of the Aluminum Company of America; and Mr. S. A. Stewart, general manager of Hamilton Standard Propellers Division of United Aircraft Corp. Mr. Charles Marcus, vice-president of the great Bendix Corp., and Mr. A. G. Herreshoff, a senior engineer of Chrysler Motors, made up a most knowledgeable and keenly analytical party.

Confronted at short notice with an itinerary drawn up by the Ministry of Aircraft Production, the Society of British Aircraft Constructors and the firms concerned prepared in a few hours a hustle programme of visits up to the best transatlantic standards. Sir Charles Bruce-Gardner, chairman of the Society—just back from the American tour—Sir Frank Spriggs, of Hawker Siddeley, and Mr. E. C. Bowyer conducted the visitors round, while M.A.P. were officially

At Avros. (Left to right) T. O. M. Sopwith, R. H. Dobson, Sir Charles Bruce-Gardner, Charles Marcus, P. G. Johnson, Roy Chadwick, G. E. Welty, I. M. Laddon, Sir Frank Spriggs, J. Carlton Ward, Ken Ebel, A. G. Herreshoff and S. Stewart.

New ground for the visitors. Capt. J. P. Black showing them production of the sleeve-valved Hercules in a shadow factory.

On one day air transport from a Communications Squadron was used. This party travelled in a D.H.86.

(Left) At a Ford Rolls-Royce Merlin factory. The uniformed visitor is Lt.-Col. E. T. Bradley, U.S. Army Air Force. (Above) Inspection of a very up-to-date Spitfire at a Vickers Supermarine factory.

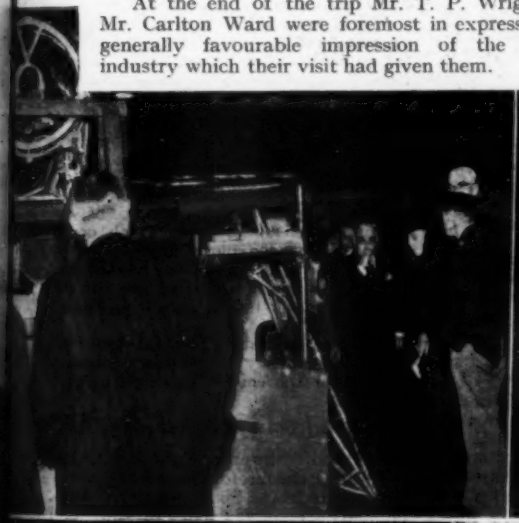
represented for the first week by Mr. H. G. Bloss, Deputy-Director of Aircraft Production (Fighters), and for the second week by Mr. J. A. C. Manson, Deputy-Director of Aircraft Production (Bombers).

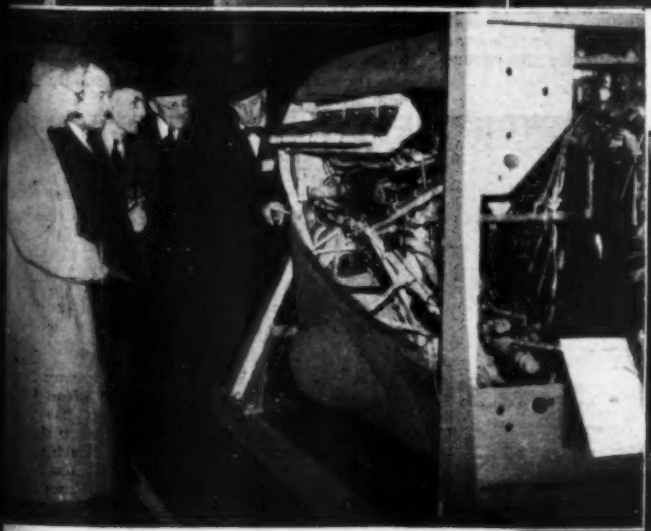
The glorious certainty that the weather would be uncertain obliged the party to depend on road transport. On only one day was aircraft the selected vehicle, and then our winter weather obliged one of the two machines allotted to the party to make a forced landing, and the whole party finished the journey into London by coach through a dense fog.

In all, the party visited 22 factories—perhaps not quite an exact figure because in two or three places the "factory" really consists in a large number of small dispersal units, so that the actual number of different manufacturing units visited was considerably higher. Our photographs show the visitors at some points of the tour. Others were the Hawker and Gloster fighter factories; the Bristol aircraft and engine works; the Rotol airscrew plant; High Duty Alloys; English Electric; other plants where engines and aircraft of parent firms' design are being made; and one or two manufacturing units whose very existence is a secret.

At the end of the trip Mr. T. P. Wright and Mr. Carlton Ward were foremost in expressing the generally favourable impression of the British industry which their visit had given them.

The party in the shade of a Handley Page Halifax at a Rootes shadow factory. Mr. Reggie Rootes is in the centre of the group.





(Above) S. Stewart and Charles Marcus interested in a Wellington's geodesics at a Vickers Armstrong's factory. (Centre) Major T. M. Barlow showing the visitors round the Fairey Aviation Company's works.

ove) Admiring a Lancaster Merlin power unit at the ls-Royce factory. (L. to R.) T. P. Wright, E. W. Hives, Ebel, A. F. H. Sidgreaves and Sir C. Bruce-Gardner. ht) Relaxed rubbernecks at the end of a day's missioning.

HERE AND THERE

Praise for the Mosquito

FLT. LT. ROSE, an Australian pilot recently returned home from this country, is quoted as saying that the D.H. Mosquito surpasses any bomber previously made.

"It is light on the controls," he said, "a joy to fly, faster than most fighters, and so manœuvrable as to hold its own in combat with enemy fighters."

Airport Wages Dispute

FOLLOWING a dispute involving workers at the Shannon Airport in County Clare, the Eire Government has undertaken an examination of the wages paid at the airport.

Wages are stabilised in Eire to prevent inflation, and it is stated that due regard will have to be paid to Government orders affecting the position.

It is understood that the men involved are employed on constructional work at the airport.

Canadian Air Mail

CANADIAN postal authorities are considering the possibility of a trans-atlantic air mail service for the benefit of their Armed Forces in Great Britain.

The matter was first mentioned by their postmaster-general, Mr. Mulock, when he spoke at a Press conference in Montreal after his return from a flying visit to Great Britain.

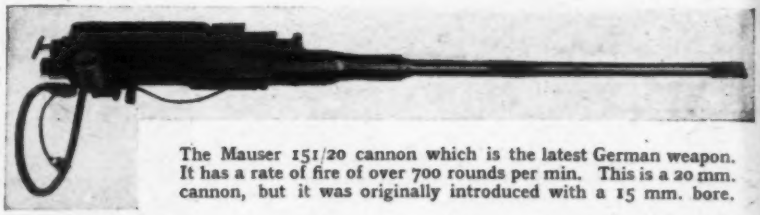
Saying that the question of priorities on the equipment and personnel needed to operate such a service would have to be considered, he added, "But I think we will have to have our own air mail service over the Atlantic to maintain contact with the men overseas."

T.C.A. Appointment

AMONG the recent changes in the operations personnel of Trans-Canada Air Lines is the appointment of a Sussex man to the post of assistant operations manager at Winnipeg.

He is E. P. "Billy" Wells, of Seaford, who joined T.C.A. in 1937 after leaving the R.A.F., and who piloted the first air mail operated by the line between Vancouver and Seattle.

Billy Wells, who is now 41 years of age, was awarded the D.F.M. for outstanding work in Iraq during the middle 20's.



The Mauser 151/20 cannon which is the latest German weapon. It has a rate of fire of over 700 rounds per min. This is a 20 mm. cannon, but it was originally introduced with a 15 mm. bore.

Conservation of Fuel

IN view of the interest displayed by readers of *Flight* in the question of conserving fuel by utilising the power-output of aircraft engines under test, it is interesting to read in a November issue of *The Engineer* that more than half the electric power required in the production of Pratt and Whitney engines at the new Ford plant at Ypsilanti, Michigan, is produced by the engines themselves.

As each engine leaves the assembly line for test, a hydraulic constant-speed coupling, linked to a generator, is attached to it, and the result is said to be a saving of fuel which reduces the manufacturing power costs by 53 per cent.

Canadian Aircraft Output

CANADA'S monthly output of aircraft is now four times greater than that for the whole of 1939, announced C. D. Howe, the Dominion's Minister of Munitions during a recent visit to Washington.

Including trainers, night-fighters, Lancasters and Mosquitoes, their monthly output totals 400 aircraft, and they are now tooling-up factories for the production of dive-bombers.

"Flight" photograph.

MAJOR MODS. A Consolidated Catalina flying boat being altered for service with British Overseas Airways. As a civil machine it retains its long-range characteristics and provides accommodation for seven passengers.

Aer Lingus Teoranta

THE terminus of the Irish Air Lines service between Dublin and Great Britain has now been changed from Barton Airport, Manchester, to Speke Airport, Liverpool, and intending passengers should note that this has necessitated a slight change in the arrival and departure times.

Although the decision to change to the terminus was not made by the operating company, it confers the benefit of better facilities for catering for the comfort of passengers and also of connections with air services to other parts of Great Britain.

International Air Force

THE post-war establishment of an international air force which could reach the most remote corners of the world and could strike at any who sought to break the peace was advocated by Sir Stafford Cripps in his recent broadcast to America.

The power of the air, he said, provided an opportunity which never before existed for the control of world order.

Cheque from Spaniard for R.A.F.

A SPANISH listener to the B.B.C. has sent a cheque for £10 to one of the announcers in the Spanish service "as a humble acknowledgment of profound respect and great admiration for all the heroes of the R.A.F., who are giving everything they have to the cause which we, the majority of the Spaniards, solidly support."

The writer adds that his letter was inspired by the "sad shadow cast by the death on active service of His Royal Highness The Duke of Kent."

The cheque has been forwarded to the R.A.F. Benevolent Fund.

From the Trade

MR. G. A. R. MEAD has been appointed a managing director of the Skefko Ball Bearing Co., Ltd.

* * *

MR. N. R. ADSHEAD, who was elected to the board of Boulton Paul Aircraft, Ltd., 18 months ago, has been appointed joint managing director of the company with Mr. J. D. North, F.R.Ae.S. Mr. Adshead is a director, among other companies, of Hydro Electric Securities and Sena Sugar Estate.

* * *

THE photograph shown in "Titanine Recognition Test No. 14" in *Flight* of November 5th was that of a Short Stirling. This completes the series.

GERMAN RADIALS

The B.M.W. 132K, 132N and Bramo Fafnir 323P-1 Aircraft Engines

DETAILS of the above engines installed in enemy aircraft which have fallen into our hands and thus subjected to expert examination have now been officially released by the Ministry of Aircraft Production. The general features and layout of all three types were well known in this country before the war.

The Bramo Fafnir 323 P-1

This engine is a nine-cylinder, air-cooled, geared radial type with petrol injection and a two-speed supercharger.

Accessories and auxiliaries are driven from a gear box constituting the rear compartment of the engine.

A hand-electric inertia starter is fitted and provision made for the operation of a hydraulic two-pitch airscrew, but actually the V.D.M. electric type is being used.

The general design is conventional and includes American pattern cylinders, Farman-type reduction-gear and manetonjointed crankshaft. The supercharger two-speed gear is epicyclic, the gear being selected by tightening one or other of two contracting brake bands encircling members of the gear trains. An automatic mixture control, motivated by boost pressure alone, and a variable datum boost control are fitted, the latter coupled to an ignition timing control.

Undue complication is evident in the boost/ignition control and in the fuel feed pump. The use of bushes, in reversal of normal practice, on the male portions of bearings (e.g., on the crankpin) is also noteworthy.

Magnesium alloys are used extensively.

The installation is designed as a unit for quick removal from, or refitting to, the airframe, all pipes, etc., being suitably marked.

The crankcase assembly of aluminium alloy forgings consists of the main body, the reduction gear housing, the supercharger casing and the auxiliary drives casing.

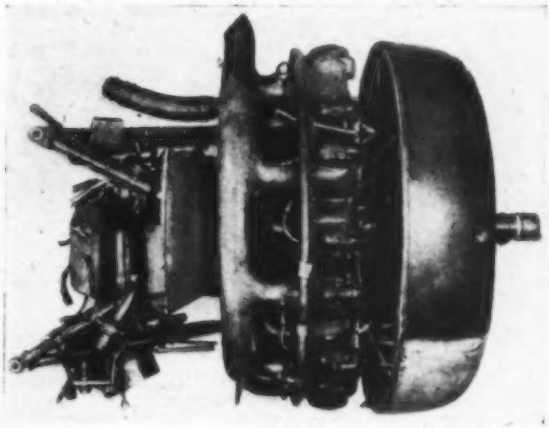
An extension of the front half of the crankcase forms a housing for the cam gear and the eighteen tappet guides. Eighteen waisted studs in the face of the cam housing secure the nosepiece and diaphragm. This is a magnesium alloy casting ribbed for stiffness and carries a flanged steel bush to house a ball bearing in which runs the nose of the crankshaft.

The nosepiece, also a magnesium alloy casting, contains the airscrew reduction gear.

On the rear of the crankcase is mounted a large aluminium alloy casting which constitutes a casing for the supercharger and its two-speed gear. Bosses are cast on the exterior of the supercharger casing to take nine engine mounting bolts and two slinging eyes.

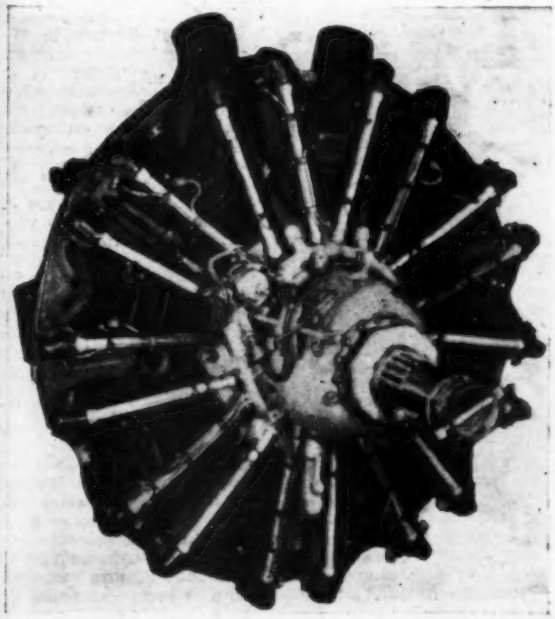
Each cylinder is composed of two portions, a head with integral rocker boxes, sand cast in a metal similar to Y alloy and a chrome steel barrel.

The forged airscrew shaft, of nickel chromium molybdenum steel, has the standard German serrated flange at the outer end. The outer end is carried in a steel housing in the engine nose by a double row self-aligning roller bearing which also takes the airscrew thrust.



Side view of Bramo Fafnir 323 P-1.

Cylinder Panel Baffles on the Bramo Fafnir 323 P-1.



Front view of Bramo Fafnir 323 P-1.

Epicyclic Reduction Gear

The reduction gear, of ratio 29:18, consists of an epicyclic train of bevel wheels. The coupling is rigidly mounted on the crankshaft splines and is machined with very short external splines to engage with splines in the driving bevel.

The gear wheels are forgings of a nickel-chromium-molybdenum steel and the greater part of the surfaces are case-hardened. The spider is forged from chrome-molybdenum and has apparently been sand-blasted externally.

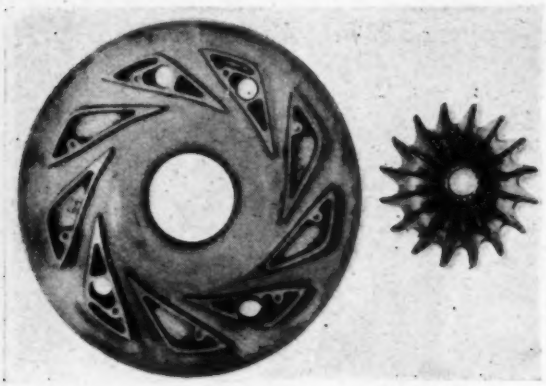
Each cylinder head is provided with one inlet and one smaller exhaust valve. The inlet valve is made from a silicon-chromium steel and the tip is hardened, while the exhaust

BRAMO FAFNIR 323

Bore	154 mm.
Stroke	160 mm.
Swept volume	26.8 litres
Compression ratio	6.23 : 1
Supercharger	Centrifugal type
Drive	Epicyclic gear train
Gear ratio	Low speed, 9.6 : 1.
	High speed, 12.4 : 1
Take-off Power	1,000 h.p.
Power on Climb	775 h.p. at 13,940ft.

D

GERMAN RADIALS



Supercharger impellor and diffuser. Bramo-Fafnir 323 P-1.

valve is of nickel-chromium steel (D.T.D.49B) and is stellite tipped and faced. Both valves are hollow.

The supercharger has a steel impellor with sixteen straight radial blades which gradually decrease in cross-sectional area from boss to tip, and are curved at the inlet edge to form entry guide vanes. Slots are machined in the leading edges of the entry vanes; these may have been originally intended to take a reinforcing ring, although in none of the engines examined was this ring present, and indeed in one the slots were absent.

Nine diffuser guide vanes of large cross-section are cast integral with the magnesium alloy plate closing the rear of the impellor chamber. The outer edge of this plate is curved forwards to sweep the air into an annular discharge chamber of circular cross-section from which the induction pipes run tangentially.

The auxiliary gear box is a magnesium alloy casting mounted on the rear of the supercharger casing. A train of gears is carried on shafts which are supported in bronze bearings in the rear wall and project through to drive the auxiliaries.

Fuel System

This is similar to that in other German installations and comprises twin feed pipes from the fuel tank leading through the fireproof bulkhead to combined cocks and filters, one of which also has a hand pump built into it, and on to a duplex engine-driven fuel pump, the deliveries from which combine and pass through a de-aerator to the injection pump. The pump embodies a pressure relief valve, returning excess fuel to the suction, but there is no provision, either within the pump or by an external by-pass, for priming the pipes on the pressure side by hand pumping. The de-aerated fuel is taken to one end of the injection pump inlet galleries and the surplus reaching the other and passes a spring-loaded non-return valve, then combines with the aerated discharge from the de-aerator and is returned to the fuel tank.

The fuel de-aerator is mounted on top of the boost control at the extreme rear of the engine. The body is a casting circumscribing an approximately spherical chamber within which is carried a pendulum on a system of gimbals having freedom in pitch and roll. The air-bearing fuel enters the gimbal system at one of the pitch bearings and reaches the outer chamber through openings in the lower parts of the double pendulum. In the other chamber separation of air and petrol is effected by density difference. The air passes to the top of the chamber, re-enters the gimbal system and passes out through a pipe concentric with the original entry.

B.M.W. 132 K and N

TWO engines were examined in detail, one a B.M.W. 132 K series 1 from a twin-engined Heinkel 115 seaplane, and the other a B.M.W. 132 N from a twin-engined Dornier 17 P aircraft. The workmanship was of a high order, but the injection equipment did not have the finished appearance of the engine generally.

The Bayerische Motoren Werke A.G. are the manufacturers of the 132K and N types, the main difference of which concerns the airscrew reduction gear and supercharger gear, the K type having a double planetary epicyclic airscrew gear and the N type single planetary gears. The K engine apparently has a lower supercharger speed and greater take-off power than the N type.

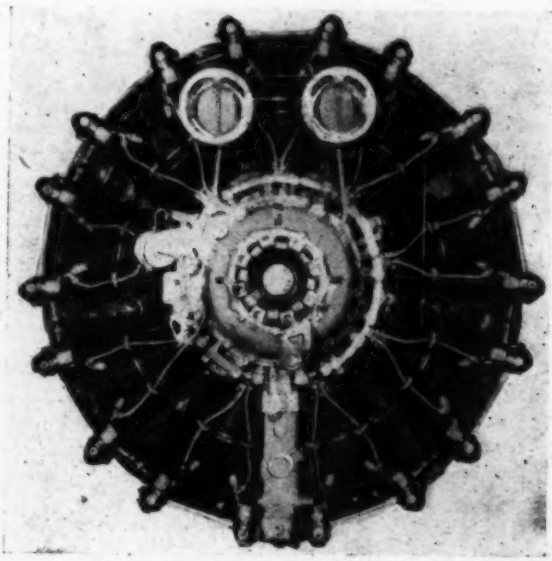
The original design was based on the Pratt and Whitney Hornet engine, but considerable alterations have been made. The bore and stroke, however, remain as in the prototype.

The B.M.W. 132 is an air-cooled, geared nine-cylinder radial engine with direct fuel injection, single-speed supercharger and fixed-datum boost control employing double throttles. The airscrew is, as mentioned above, driven through epicyclic reduction gearing, and provision is made for supplying oil pressure to a hydraulic mechanism, when fitted, for airscrew pitch variation, as an alternative to the standardised V.D.M. electrical gear.

The twin spur planet epicyclic reduction gearing for the airscrew of the K type engine provides a ratio of 44/61 times crankshaft speed, while the single planet gear of the N type gives a reduction of 13/21.

Supercharger gear ratios are 7.02/1 and 10.14/1 respectively to drive a 24-bladed impellor, of which 12 blades are cut away at the entry. Delivery is made through an 18-vane diffuser.

Fuel injection is regulated by an automatic unit which varies the quantity in accordance with the boost air pressure and temperature effects on a capsule, the response of which moves the injection pump plunger control rack through an oil servo.



The B.M.W. 132 N—front view. Petrol injection and a two-speed supercharger are incorporated.

Points of interest in the design are the crankshaft assembly by means of a tapered maneton joint without bolt; the somewhat intricate sump and oil pump design; pressure lubrication of the valve rockers; the elaborate oil sealing of the supercharger, and the use of ball and roller bearings with oil feed holes through their outer races.

Accessories and auxiliaries are driven through several trains of spur pinions radially disposed about a central driving shaft in the auxiliary gear-box at the rear of the engine on which the units are mounted.

The crankcase is in two halves bolted together with nine through-bolts, and cast in aluminium alloy. Pegged into each half, steel rings form housings for the roller bearings of the crankshaft.

The crankshaft, built up on a frictioned grip maneton joint, is in two sections, the shaft and crankpin being

integral with the forward crankweb.

Eight auxiliary rods of H section form a normal assembly articulated around the flanged big-end of a master rod fitted in No. 5 cylinder. This carries a fixed steel big-end bush lined with lead-bronze located by two lugs on the big-end engaging with checks in the flange. Lubrication is effected by oil caught in an annular groove near the plain end of the big-end bush, and a lip at the flanged front end.

Gudgeon and wrist pin bearings are phosphor-bronze bushed, the former being oil mist lubricated through two holes provided in the outer end of each rod.

The pistons, of silicon-aluminium alloy (Lo-Ex), are flat topped, recessed to clear the valve head rims and internally webbed. Three compression rings and one channelled and drilled oil controlling ring are fitted above the gudgeon pin and one bevelled scraper ring below.

Cylinders with steel barrel and aluminium alloy (with 10 per cent. copper) head are close finned, with a total radiating surface of approximately 20 sq. ft.

Exceptionally close air baffling is employed on head and barrel, the total exit and entry areas being approximately 40 and 63 sq. in. respectively per cylinder.

Seatings, faced at 45°, of 10 per cent. aluminium-nickel-iron bronze for the inlet and nickel-chrome-tungsten steel for the exhaust valve, are shrunk into the head.

Both 14 mm. sparking plugs are situated in the front, and the fuel injection valve at the rear.

The cylinder barrel, of chrome-molybdenum steel, is screwed and shrunk for approximately 2in. into the head, 1in. of which length is threaded.

Temperature Measurement

A thermo-couple is embedded in the base flange of each cylinder for temperature measurement, and provision is made for a second couple at the rear of the cylinder head, under the exhaust port. The base couple is of iron-constantan, and each wire is brazed to a small brass plug which is held in the bottom of its hole drilled in the flange by a driven-in copper tube.

The austenitic steel exhaust valves have hollow sodium-cooled stems and heads, sealed at the stem tip with a welded-in plug of similar material, the stem tip and seating being stellite faced. The inlet valves are of solid silicon chrome steel, hardened and tempered, with dished heads. Two concentric springs are used for each valve, held by collars and split cone cotters. Safety circlips are fitted to the valve stems.

The rocker covers are stamped "Nural," an aluminium-rich alloy containing 5 per cent. silicon, and the steel rockers are fitted with spun-in balls, flattened to make contact with the valve stems and held in screwed adjusters. The rockers are drilled for forced lubrication of their phosphor-bronze bushes, push-rod contacts and valve stem end balls, receiving oil from the main pressure delivery line by way of the drilled tappets and tubular push-rods.

In the method of rocker actuation the designers have made no departure from the American prototype.

Immediately behind the crankcase a single-speed centrifugal supercharger impeller is housed in an aluminium alloy cast casing, partitioned by two bulkheads between which an air duct of volute formation leads from the twin overhead intakes to the centre of the 24-bladed impellor. The air intake is thus located between the supercharger and the crankcase, and no fixed guide vanes are provided for incoming air. Twelve vanes of the aluminium-alloy impellor are full bladed, the remaining twelve being cut away as shown. The impellor delivers through an 18-vane diffuser integral with the front wall of the auxiliaries gear case to an encircling induction manifold from which the air passes by tangentially disposed induction pipes to the cylinder ports.

Rear view B.M.W. 132 N engine. The original design was based on the Pratt & Whitney Hornet, but considerable modification has been made.

The aftermost section of the engine, immediately behind the supercharger, forms with cover the auxiliary gear box with trains of spur pinions radially disposed about a central driving shaft which serves also for engine starting, and ends in a flanged dog coupling to engage with an inertia starter mounted on the rear cover. Mounted on the rear splines of this shaft is the driving wheel to the supercharger gears.

Housed vertically in a sump of peculiar design, with cored flange attachments to the cam wheel case and the supercharger section, the gear-type oil pumps are driven at 129/112 times crankshaft speed by a short spline, at the bottom of a vertical spindle which has a small integral bevel pinion at the top engaging with a crown wheel riveted to the cam ring wheel.

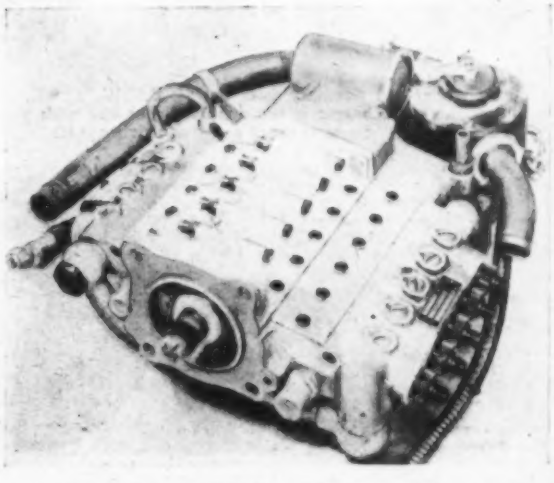
The main body of the sump is partitioned horizontally into an upper and a lower scavenge chamber, the lower section being vented by a vertical pipe to the top of the upper. The remaining space forward is occupied by the pumps and the pressure filter chamber, which opens through a spring-loaded non-return valve into a delivery distribution chamber. The filter is of the edge-plate type and can be cleaned by turning the squared end of the spindle by a suitable handle, a drain plug being provided in the body for sludge removal. Suction and delivery pipes traverse the casing from front to rear.

Pressure Delivery

The pressure pump suction from the service tank is piped forward through the lower chamber and cored to the port in the bottom pump cover. Pressure delivery is made through a cored passage to the filter chamber and the distribution chamber, where it then divides. A relief valve is fitted at the front of the sump providing a relief to the pump inlet.

Oil passing forward from the crankshaft bore lubricates the airscrew shaft rear spigot bearing and the airscrew reduction gear by way of the hollow airscrew shaft.

Valve tappets and guides are lubricated through a ring gallery piped from a branch junction on the main vertical



Injection pump on the B.M.W. 132 engine. Similar in design to that used for C.I. engines with necessary lubrication arrangements added for operating with petrol.

GERMAN RADIALS

B.M.W. 132 K and 132 N

Bore	6¼in.	
Stroke	6¾in.	
Compression ratio	6.93/1	
Swept volume	27.7 litres	
Supercharger gear ratio	K engine	N engine
	7.018 : 1	10.1406 : 1
	K engine	N engine
Power-take off	960 h.p.	865 h.p.
Rated h.p.	690 h.p.	665 h.p.
	5,900 ft.	14,760ft.

pressure pipe, rising from the oil pump. Holes in the tappets and the ball feet of the tubular push-rods register to transmit lubricant through holes at the push-rod ball heads to the rockers, which are aso drilled through to the bearings, and to the flattened ball tappet in the rocker heads. The auxiliary gears and ball bearings are lubricated by oil mist.

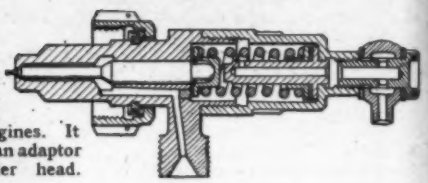
Gudgeon pins, cylinder walls, main crankshaft bearings, thrust bearing and forward roller bearing are splash and mist lubricated.

The upper sump chamber receives drainage from four engine sections, the auxiliary gear box, that from the supercharger section, the crankcase, and the camwheel casing. The whole of this is evacuated from the bottom of the chamber through a perforated suction duct which registers with the main scavenge pump suction port.

Oil Venting Arrangement

The next scavenge section of the oil pump, immediately above the main scavenge, draws through external piping, from a suction strainer in the base of the lower sump chamber, which collects drainage from the valve rocker boxes, and the return from the V.P. airscrew line. Scavenge oil from the rocker boxes is piped down by a ring gallery to the bottom of the lower sump chamber. The topmost scavenge pump section drains from a small sump by which an oil level is maintained in the nose section, the oil passing through a drilled hole in the cam wheel casing to inlet pipe.

The venting arrangements for the engine and sump are somewhat elaborate, probably to prevent undue loss of oil. The breather hole, in the crankcase after-wall, vents into the space intervening between this bulkhead and the forward bulk-



Section through fuel injection valve, identical on all three engines. It is screwed into an adaptor on the cylinder head.

head of the supercharger casing, which has four breather holes (three in the "N" engine) of graduated diameter communicating with an interior compartment cored out of the space adjacent to the air intake volute passage.

Communication with the atmosphere (probably through the oil tank) from this venting compartment is made through a breather fitting, which is also in direct communication, by an external pipe, with a vent at the top rear corner of the sump.

Boost pressure is regulated by throttling the twin air intakes which are protected against icing by wire shields. Two butterfly throttles in tandem are fitted at the mouth of each intake pipe, the rear pair being linked, are directly controlled by the pilot, the front pair being connected by link to the fixed datum boost control.

The boost control unit is a compact assembly of four elements: mounting bracket, capsule chamber, servo cylinder and piston valve chest, and a crankcase bolter together and mounted on the after sweep of the port air intake.

Fuel from the tank is fed by the engine-driven feed pump via a de-aerator to a Bosch injection pump, whence it is supplied through nozzles to the engine cylinders. All the fuel circulated by the feed pump is passed through the injection pump inlet galleries, that in excess of engine requirements together with air from the de-aerator being led back to the tank.

Two non-return valves are fitted in the system, one to prevent air in the return line between de-aerator and tank from entering the galleries, the other set to maintain the fuel in the injection pump feed line at a pressure of between 14 and 21 lb./sq. in. gauge.

The fuel feed pump is of the oscillating cylinder reciprocating plunger type, and mounted on the auxiliary gearcase cover, being driven at 9/7 times crankshaft speed.

The fuel de-aerator is similar to the type used on the Mercedes-Benz D.B.601A engine, consisting of three parts, body, pendulum and cover.

The fuel injection pump is similar in design to that used for C.I. engines, but with the necessary lubrication arrangements for pumping petrol.

The charge injected is controlled by an automatic unit proportionally to some function of the absolute pressure and temperature of the boosted air, some of which is circulated through the chamber containing the controlling capsule. This capsule operates a piston valve which admits engine oil under pressure alternatively to either side of a servo piston connected by links and a lever to the pump delivery controlling racks. An additional external manual control is provided for enriching or weakening the mixture.

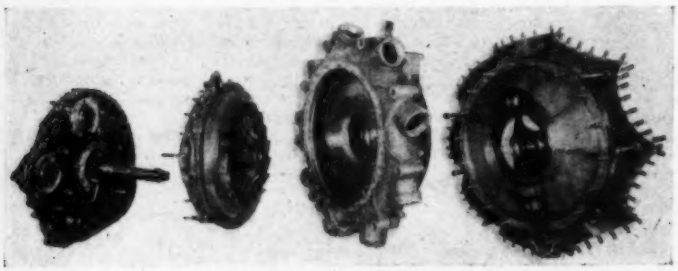
Injection Pump Operation

The pump consists of nine plunger elements, one for each inverted cylinder, the plungers being depressed by cams and returned by springs. The ascending plunger uncovers two circular ports to the fuel gallery, which remain open for 140 degrees of camshaft rotation permitting fuel to enter the barrel. Fuel is spilled through these ports on the next outer stroke until both are closed by the descending plunger when injection commences. Delivery ceases when one of the circular ports in the barrel is uncovered by a helix cut in the plunger, when the fuel is displaced back into the supply gallery.

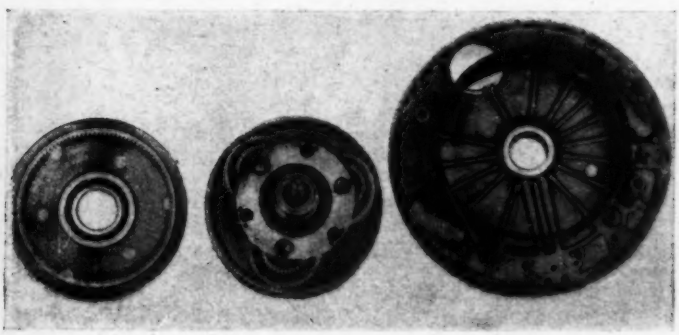
The barrel has two circular ports, one for metering, and the second to assist in filling the pump chamber. The pump has two lubricating oil supplies, one a self-contained system for the cams and bearings, tappets, and main operating racks, and another high-pressure supply from the engine system for the plungers. A supply from the engine pressure system is also used to operate the servo control unit.

The fuel control unit assembly comprises two assemblies: a capsule chamber and a servo unit.

(*Continued on page* 607.)



Supercharger and auxiliary gear drives, B.M.W. 132 K. Immediately behind the supercharger is the auxiliary gear box with pinions radially disposed about a central driving shaft.



Supercharger two-speed gear, Bramo Fafnir 323 P-1. An internal view showing the epicyclic gear designed to give two alternative ratios.

BEHIND THE LINES

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

Italian A.R.P.

IT is reported from Rome that the Italian Ministry of Education has introduced A.R.P. training as a compulsory subject in all schools. It is stated that in view of the growing air-raid danger it is vital to the safety of Italy that all school-children should know what to do in air raids.

Special squads of children will be formed to help to protect school buildings, etc., and to "play effectively their part in the passive defence of Italy."

Nervous

THE Germans appear to be growing increasingly nervous about the possibility of an Allied invasion of the Continent. Despite their Press and wireless propaganda, designed to ridicule such prospects and to calm the population, elaborate precautions are being taken. In Holland, for instance, military manœuvres are reported to have taken place and an inspection of all defensive measures completed by General der Flieger Christiansen. Special importance in these exercises is said to have been placed on intensive preparations for defence against Allied parachutists and air-borne troops.

Henschel 129

THE Henschel 129 is mainly used by *Schlachtgeschwader* of the *Luftwaffe*, which can be best described as ground strafing units. The aircraft is stated to have an approximate speed of 285 m.p.h. Only the cabin is protected by armour plating.

Two different varieties of armament are reported: one version is equipped with two machine guns and one 30 mm. anti-tank cannon; the other is fitted with two 20 mm. cannons and two machine guns. The bomb load of the Henschel 129 is approximately 770lb. The main purpose for which the Henschel is employed is in breaking up concentration of tanks.

An Estimate

THE Italian Daily *Il Popolo di Roma* reports that *Luftwaffe* units supporting the German forces in the Nalchik (Caucasus) sector number 1,250 aircraft of different types.

A German Glider

IN addition to the Ju 52 which the Germans use to maintain their supplies to North Africa, they also employ gliders towed by these three-engined aircraft. The gliders are built by the Gothaer Waggonfabrik A.G., of Gotha, and have tubular tail booms. With a crew of two they are capable of carrying 21 air-borne infantrymen, or the equivalent weight in supplies. It is possible that, in view of their heavy losses in Ju 52s, the *Luftwaffe* will make increasing use of these gliders for the carrying of fuel supplies to Tunisia. The Gotha glider has a span of 79ft., length 52ft. 6in., height 5ft. 4in. and a wing area of 762 sq. ft. Empty weight is 3,200 lb., and gross weight 8,500 lb.

Passive Resistance

THE first report published in the Italian press about the Allied landings in North Africa is an interesting and curious admission of failure. "Immediately after the first news of the concentration of shipping in Gibraltar had been received," says the report, "Axis reconnaissance aircraft took off and penerated as far as Gibraltar.

"On November 6th the departure of Allied ships from there was observed and from then on German and Italian air reconnaissance units kept a constant watch. Thick fog forced the Axis reconnaissance machines to go down within the range of A.A. guns, but, despite this, constant alterations and minute details of the Allied movements were observed and reported.

"On November 7th Axis reconnaissance units were further strengthened to make quite sure of any movement of the British and Americans. The convoy split slowly into smaller and larger groups and it became evident that there was no intention to pass the Straits of Sicily.

"From that day on, four-engined American bombers and R.A.F. fighters surrounded the convoy. New Allied aircraft were continuously starting from aircraft carriers. But despite all this, each movement on the Algerian Coast was closely followed up by Axis reconnaissance aircraft. From the early morning hours till sunset on November 8th Allied operations on the French North African coast were observed in detail."

But no action was taken. The report fails to explain why and leaves it to the reader to guess, stating that only "towards the close of the day torpedo aircraft of the *Regia*, accompanied by German bombers, were sent out to attack." These aircraft are said to have reached Algiers at night and to have attacked Allied shipping anchored there. "A smoke screen was immediately put up by the Allied Navy and a wild A.A. fire opened." The report states further that nevertheless some fires could be observed.

"On the morning of November 9th a German aircraft saved the crew of an Italian torpedo aircraft force-landed in the sea, which had sunk an Allied cruiser."

This is all it is claimed. It is significant that despite such careful and close reconnaissance for two days the Axis was so inactive. Even the usual claims are this time very moderate and no explanation is tendered why the *Regia*, the Italian fleet and the *Luftwaffe* have tolerated the movement of such masses of shipping and offensive operations of the Allies in *Mare Nostrum*, right in front of their very eyes.

Perhaps Allied aircraft, which, in the words of the Italian report, "surrounded the convoy like a swarm of bees" has made them apprehensive.

GERMAN RADIALS (*Continued from page* 606).

For a given change in boost pressure the capsules expand or contract a fixed amount, allowing the valve to move down or up, so opening one side or other of the servo piston to oil pressure, causing it to move the control racks through the interconnecting links and so rotate the plungers. While moving, the piston rod transmits motion through the rack and pinion to the cam, this cam being so shaped that, for a given displacement of the foot and consequent movement of the valve, the piston moves the required amount before the cam returns the valve to the balanced position, so cutting off the oil pressure supply.

The control capsule is also sensitive to the temperature of the air from the supercharger volute, some of which is circulated through the capsule case by a pipe, the mouth of which collects air at the diffuser vane exit between No. 5 and 6 cylinders, in the volute, and being returned through a pipe which has an elbow opening concentrically into the volute tangential exit to No. 7 cylinder induction pipe.

The long-chord cowling has eighteen gill segments at the rear to control the engine cooling air flow, operated by an electric motor through worm gear and links. An oil servo system is also used, the servo unit being fitted inside the cowling at the top and moving the gills by an arc rod and links controlled by a spring-loaded two-way cock in the cabin. The oil servo utilises pressure fluid from the hydraulic system, which is also used to operate the oil cooler air control flaps by a thermostatically controlled servo unit. Forward facing pipes supply air for cooling the air compressor and generator.

The cowling opening is 43¼in. diameter, the front ring being connected by rubber-bushed bolts to the front of the valve rocker boxes through ball and socket joints.

An exhaust manifold is fitted inside the cowling at the rear of the engine, having a single flared rearward facing outlet at the bottom, starboard side. An air heater pipe, 2¾in. diameter, with a forward facing opening between the cylinders, is fitted concentrically inside the exhaust manifold.

A priming nozzle is fitted in the cylinder inlet elbow adjacent to the nozzle leak-off pipe connection on No. 5 and 6 cylinders only, or priming can be automatically arranged, the fuel being injected while the engine is turned by the starter.

THE AIR FREIGHTERS

Aerial Lorries Too Small : 60-ton Plastic-wood Troopers Wanted

By E. N. B. BENTLEY, A.F.R.Ae.S.

THE need of the United Nations for air freighters is no longer a question, but a self-evident truth. What *is* in question is the time it would take to design and build such aircraft, and how much of our aeronautical engineering resources should be diverted from their present work to the construction of these freighters.

Before answering these questions it is necessary to consider the uses to which the air freighters would be put. And there is a fundamental difference between our conception of their use, and that of the Germans. The bulk of the German freight and troop carrying aircraft are obsolescent, inefficient (from the aeronautical point of view), and comparatively small, built in very large numbers even before the war began. They are used in direct support of the troops in action and, as in the case of the troops themselves, losses are of no account provided that their object is achieved.

The German victory at Crete and the relief of the army surrounded at Staraya Russa are outstanding examples of these tactics. Our air freighters must carry big loads, sometimes over 2,000 miles or more, but will not generally be expected to operate in the actual battle area. They should be able to carry eight or ten tons payload (in addition to their fuel) across the Atlantic, and twice that payload over shorter distances. The load may vary from such comparatively light and bulky things as important passengers, to concentrated heavy loads like aircraft engines or boxes of ammunition. Not only must there be room for such loads inside the machine, but also a large enough opening for them to be easily loaded on board. This latter requirement, though obvious, is exceedingly difficult to achieve in the highly stressed structures of normal aircraft design.

Rebuilding Bombers ?

It has been suggested that some of our older bombers might be converted to passenger and cargo carriers, and this has been done in a few cases. But a bomber, which carries its compact but heavy load in a long narrow compartment under the floor, cannot carry anything like the same load of passengers or cargo in the space available. A far more efficient use of existing material would be the removal of engines, airscrews, instruments and so on, for incorporation into air freighters designed for the work.

The time taken to design an aircraft depends on so many diverse factors (including very often a factor of optimism) that it is extremely difficult to fix a limit. One of the few certainties is that hardly anyone who is not closely connected with aircraft design has any real idea of the immense amount of work involved. In addition to aerodynamic research, the strength of the structure under all conditions has to be accurately calculated for every part, from the whole machine to the smallest bolt. So also have detailed drawings to be done of each part and assembly. Plans have to be made for the allocation of material, and the amount of labour, machine tools and factory space required for the making of each component of the aircraft. So that many thousands of hours of work have to be done before actual construction can begin.

An enthusiastic and competent design staff given the full backing of the Ministry of Aircraft Production, and provided with the necessary labour and manufacturing facilities could, I believe, have a freighter ready to fly within eighteen months from the word "go." But to achieve this it would be necessary for everyone on the job to be imbued with the idea of the extreme urgency of the work, and to go to it in the same spirit as our munition workers did after Dunkirk. The rate of production after delivery of the first machine would depend mainly on the amount of labour and manufacturing facilities allotted to the project.

For rapid design and construction and universal use, a landplane is preferable to a flying boat, as the facilities here for building and operating landplanes are very much more numerous than those for flying boats.

To carry a ten-ton payload over long ranges (needing 14 tons or so of petrol) the fully loaded weight of the freighter would be between 50 and 60 tons (that is about twice the weight of our Short Stirling bomber) and the total power would be 6,000 to 8,000 h.p. The cruising speed would be upward of 170 m.p.h., depending on the power of the engines; and the maximum duration 12 to 14 hours. For short journeys of five or six hundred miles the petrol load would be reduced and the payload increased to about 20 tons.

Reinforced-wood Structure

In spite of its size it is probable that the structure of this aircraft could, if designed on the right lines, be made actually lighter (in proportion to the all-up weight) than existing types. Wooden construction, taking advantage of the new technique of reinforced wood and thermo-setting plastic adhesives, would not only make for light and easy construction but would avoid the necessity for using light alloys and steels wanted for our fighters and bombers.

The design and construction of these freighters must be done with the least possible reduction in our output of existing military types. That might best be achieved, so far as design is concerned, by inviting tenders from those smaller firms engaged mainly on trainer and non-operational types of aircraft, thus leaving the design staffs of the actual war aircraft free to continue their policy of improvement. Although the size of a firm sets no limit to its designing abilities, it does of course affect its capacity for the construction of large numbers of aircraft. The remedy in this case might be to build the prototype and such others as could be built here; and let the greater part of the production order be built in Canada.

Before considering the various ways in which the air freighter could be used, it is useful to know what loads it is capable of carrying. One hundred and fifty fully equipped troops would be well within its capabilities, even over long distances. Half a dozen anti-tank guns and ammunition is the sort of load which might turn a near defeat into victory. 2,500 gallons of petrol, or a dozen spare aircraft engines might make the difference between a squadron of fighters being grounded or in the air for a vital few days.

These are examples of what a single air freighter could do. With a fleet of them a nightly service could be run from Alexandria to Malta; anti-aircraft guns and dismantled fighter aircraft could be flown to the central Russian front from Persia; and small arms and ammunition could be sent from India to China.

There is no doubt that large air freighters can make a vital contribution towards winning the war. Of equal, if not greater, importance is the fact that they can immediately start a new lease of life on civil air transport duties, when the war is over and fighters and bombers lie idle all over the world.

Christmas Airgraph Rush

OVER a million people handed in airgraph letters addressed to the troops in the Middle East, and places beyond, on the last posting day for Christmas delivery.

Another 50 women had been added to the airgraph section at the G.P.O. in London, and still another 50 came on duty at the end of last week to handle heavy incoming mails from the Middle East.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

DE HAVILLAND CO. DENY TROUBLE

Statement in the Lords

IN the House of Lords on November 17th, Lord Simpill is reported to have mentioned the De Havilland Aircraft Company as suffering from troubles between the financial and the technical sides.

It is inevitable that a report like this has caused some concern in my company, and must give rise to anxiety outside among those interested in our many and great responsibilities. Therefore I shall be grateful if you will allow me to refute the statement as having no vestige of truth in it whatever.

A high degree of harmony and enthusiasm pervades our whole organisation.

For the De Havilland Aircraft Co., Ltd.
F. T. HEARLE,
Managing Director.

COMPOSITE NON-SUCH

The Anson Undercarriage

IN the copy of *Flight*, November 5th, you published Composite Non-such No. 2, in which you state the port undercarriage to be that of the "Anson."

Although I have never seen an "Anson" on the ground, I have always believed that the undercarriage of the "Anson" retracts forward, whereas that in the picture retracts backward; in fact, the port undercarriage looks more like that of the "Oxford" than any other machine.

Have you made a misprint, or has my recognition suddenly gone haywire? J. KLETZ.

[Our drawing was correct, showing the long radius arm *behind* the main legs of the undercarriage.—ED.]

THE TORPEDO BOMBER

A Not Too Optimistic Specification

IN answer to correspondents' letters which appeared in *Flight* of October 29th, I would like to make the following comments. "Aero" suggests that a boosted-up version of the Beaufighter could be used as a torpedo bomber, but Mr. J. W. Wood says that defensive armament is essential. The armament of the Beaufighter is purely offensive, as all its cannon and machine-guns are fixed and fire forward. This would be useless against enemy aircraft, which would usually attack from behind and on each side, and if it turned and fought them, its manœuvrability would be hampered by the weight of the torpedo and extra fuel. Also it would fail in its primary object as a fast torpedo bomber.

Some of your correspondents think I am over-optimistic, but if they would refer to the American B-26B (the Marauder), which is now used as a fast torpedo bomber, they will find how little I have exaggerated. In many respects it nearly agrees with my specification. Here are some of its dimensions and performance figures: Span, 65ft.; length, 58ft.; height, 20ft.; wing area, 525-600 sq. ft.; total of 3,700 horsepower (now 4,000 h.p.); maximum speed of 346 m.p.h.; weight loaded, 26,625 lb. (including the armament); and a tricycle undercarriage. Two torpedoes could be carried side by side in the wide fuselage.

I knew my specification could not be perfect, with its narrow limits of performance figures described. The matters of control and wing form would have to be further investigated. As the arrowplane does not seem to meet with approval, my specification could be modified into the conventional type of plane, like the Marauder. R. HUDSON.

BOMBER ESCORT

Support for E. J. Griffiths' Suggestion

THE letter on the potentialities of the Lancaster as an escort fighter, published in the November 19th issue of *Flight*, is, in my opinion, the most interesting to appear in your Correspondence pages for some time.

While my knowledge of aviation and air warfare is largely of an academic nature, I would like to make a few observations on the possibilities opened up by this rather novel conception of the heavily powered and heavily armed and armoured escort fighter—literally a "Flying Fortress."

If, as Mr. Griffiths suggests, the fighter were merely a modified version of the bomber it was escorting, then the pilot of an attacking enemy machine would have difficulty in assessing the defensive power of the raiding force, and also the defensive power of the particular aircraft he was about to attack. Such a state of affairs is likely to cause him some anxiety, and he is less likely to press home his attack with any degree of determination if there is the chance of being opposed by 37 mm. cannon instead of 0.303 Brownings.

Further to confuse the enemy, the relative number of fighters and bombers might be allowed to vary considerably, just as is the case with fighters and fighter-bombers when they go into action together. For shooting up specific objectives, e.g., barracks, airfields, merchant shipping or enemy supply columns, the four-engined fighter with large-bore cannon would prove a very lethal weapon indeed, since its heavy armament could be employed at will either for defensive or offensive action—an essential qualification for any machine operating in the swiftly changing conditions of modern warfare.

STUART W. GREENWOOD.

SEVERSKY SPEAKS OUT

Support for British Aircraft

AFTER reading Mr. Hewes' reply (*Flight*, November 12th) to my letter in *Flight* of October 29th, I feel compelled to take up a little of your valuable Correspondence space in order to defend myself.

First, I say that the British people have not, so far as I know, displayed any lack of willingness to face facts, however unpleasant. I maintain that few peoples could have taken the bad news which we have (up to now) in these last few years and not gone under.

To answer No. 2, I say: What has a direct-injection engine got over a normal unit, other than performance at height? If Mr. Hewes will be good enough to turn up his back numbers of *Flight* he will see a highly technical and interesting article on the comparisons between a German D.I. unit and a Rolls-Royce "Merlin" with normal carburation. As the technical data published in *Flight* are, in my opinion, without equal, I prefer to believe that one is as good as the other, and that apparently, is the conclusion arrived at.

To the almost comic allusion to the dive-bomber, I am surprised to see an obviously intelligent person taking an interest in such a plane after its many failures against well-organised fighter forces. We seem to have done pretty well without them up to now. We can get American machines if they are wanted, so there is no need for us to waste time and money in the development of them. Before I pass from the question I should like to remark that the Russians do not appear to need them very much, and the Germans have almost given them up in Africa and Europe.

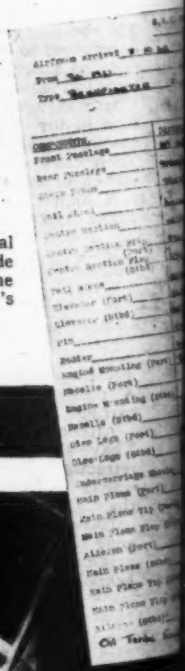
To the last of the answers to my letter I say this: Does a plane have to be in operational service before it is admitted to be the world's fastest? Surely not. War paint does not make all that difference. In addition to this, the figure given in *Flight* of November 12th as the speed of the Spitfire MK V is "over 400 m.p.h." According to the latest data available on the Fw 190, the top speed is 390 m.p.h., and that with the override-boost on the throttle engaged, and as I prefer to believe *Flight's* figures I cannot quite see where the "world's fastest" comes in. Lastly, in regard to the Hurricanes and Spitfires not being good enough for our pilots, I think it is obvious that the present marks—that is, the IIB, IIC, VB, and VC are as great an improvement on the originals as to be new aircraft; I do not think our pilots grumble, anyhow!

Finally, by way of argument, I should like to point out to Mr. Hewes that the enemy is rather far behind in the really important equipment of his air force. I need only mention four examples: The lack of a heavy bomber comparable with the Lancaster, Stirling or Halifax; the lack of a power-operated gun turret (multi-gun); the lack of a really fast day bomber like the D.H. Mosquito; and the lack of a powerful in-line motor of over 2,000 h.p. like the Napier Sabre.

G. S. HENDERSON.

Bristol Aeroplane Compa[ny]'s System of Aircraft Salvage : Ev[ery] Piece of Usable Material Preser[ved]

(Left) A burnt Beaufighter arrives at the salvage depot.



(Right) A typical report as made out by one of the Bristol Company's inspectors.

REDUCING to PRODUCE

BY a long line of sheds, which were once used for shell-filling in the 1914-18 war, long 60ft. trailers (known as Queen Marys) arrive with wrecked aircraft on board. Some of these aircraft are in reasonable condition, some show signs of severe burning, and others are little more than a heap of pieces of twisted metal which has been swept up in some field. These wrecks are the raw material for the Bristol aircraft-salvage depot.

In peacetime it would, in most instances, be just scrap, but to-day every tiny part is carefully dissected, inspected and then used again if it is found to be in sound condition.

When the wreckage arrives, it is carefully gone over by an inspector of the Bristol Company, who makes a recommendation which is approved by the A.I.D. inspector. Such major portions as fuselages which can be used again have the damaged parts removed, and these parts are replaced from other crashed aircraft which have suffered in a different manner. This process is known as "cannibalisation." If, however, repair is not considered practical, the part is marked with a chalk R to P—which means reduce to produce—and the process of stripping begins.

All the separate items are carefully removed and put in their appropriate place on the feeder benches. Hydraulics in one heap, flying controls in another, pneumatic lines and controls in another, and so on, for the whole of the various components. The parts are then degreased and cleaned, and sent to the appropriate department where specialised attention necessary for each different part is given. Except for patching small areas the metal wing and fuselage covering is not used again in construction, but is made into rough bins to take other parts before it is finally baled up and sent for resmelting.

It would be impossible, in the space available, to describe all the hundreds of detailed items of salvage work that are carried out, but on a broad basis this is what happens: A careful examination of each part is made by a qualified inspector, who passes them as usable or otherwise. If passed O.K., they receive a stamp, and are given labels bearing both the Bristol Company's part number and the appropriate R.A.F. number. If not wanted for cannibalising some major unit, they are put in store and entered in card indexes ready for re-issue to various repair depots all over the country.

Having been marked R to P, dismantling of the cockpit begins. This work is mostly done by women who form 75 per cent. of the depot personnel.

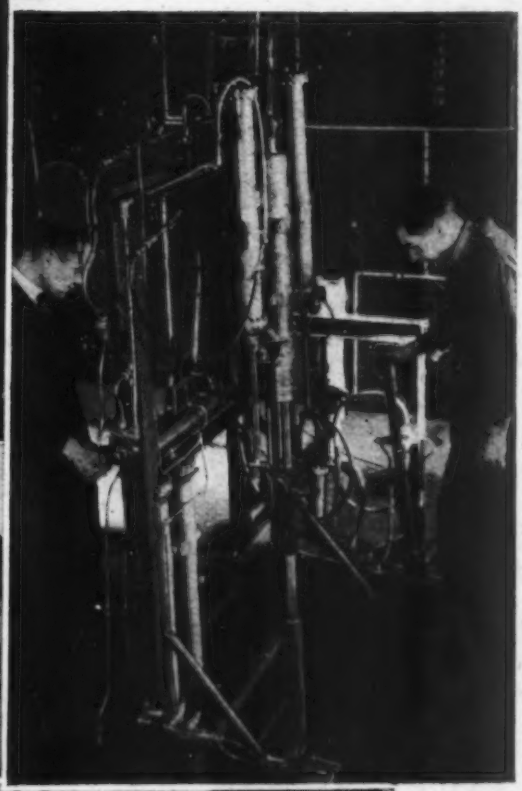
There is, of course, a surfeit of some parts, which never seem to get damaged, however serious the crash might be, and these are sold back to the Bristol Company for use on production machines. Bristols have to buy these parts because they belong to aircraft which have already been sold to the R.A.F.

It is a revelation to go through this seemingly endless number of sheds. In one can be seen undercarriage legs

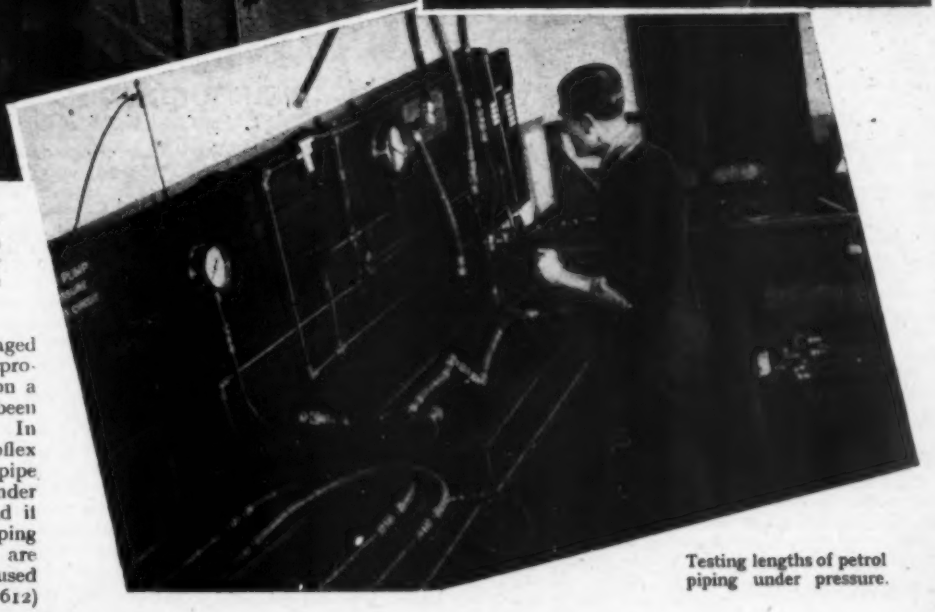
The Art of "Cannibalisation" : Test Rigs Built from Scrap

(Left) Taking the metal covering from a badly-damaged wing.

(Below) An undercarriage test rig built from salvaged parts.



(Above) A "cannibalised" main spar being built up from salvaged parts under the watchful eye of the firm's inspector.



Testing lengths of petrol piping under pressure.

built up from salvaged parts and the final product being tested on a rig which has also been built from scrap. In another shed Petroflex and Superflexit pipe lines are tested under severe pressure, and if any signs of weeping appear, the pipes are cut down and used

(*Continued on page* 612)

SPITFIRES ABOVE 40,000 ft.

Three of the German High-altitude Machines Brought Down in Egyptian Area

FOLLOWING is the amazing account of how three British pilots between them attacked on different occasions, and ultimately brought down, three of Germany's high-altitude reconnaissance aircraft. The feat is the more impressive in view of the fact that whereas the German machines are fitted with pressure cabins, our pilots did not, so far as can be gathered, have even pressure suits to assist them in the arduous task of flying and fighting at heights of "nearly 50,000ft."

The German long-range reconnaissance aircraft, the Junkers 86, designed to fly in the stratosphere had been known of for a long time. With powerful engines and enormous wing span it had been designed to rise above the ceiling of any existing fighter and, flying at a leisurely 200 m.p.h., to get away with photographs that would be of the utmost strategic value to the enemy.

Almost the first time the Germans employed the Ju 86 in the Middle East three test pilots decided that it could be intercepted. They asked to be allowed to make the attempt. Official approval was given.

Too Old at Forty?

The first pilot to take off on interception was Reynolds, a flying officer from Kenya. The medical people had some misgivings about employing him for high flying, since this is work which calls for all the fitness of youth, and Reynolds is nearly forty. Indeed, he did not take up flying until he was thirty-five, when he bought his own aircraft to get about in East Africa for his work as an executive salesman, and he has not undergone any instruction in the R.A.F. In many months of test flying he never damaged an aircraft.

Reynolds went up above 40,000ft. many times—and got the first Ju 86. He followed it far out to sea until he was close enough to open fire with his cannon and saw the starboard engine of the enemy aircraft catch fire. It went into a dive and disappeared in the haze.

For a man of Reynolds' age this high flying was a great feat of endurance. An ascent above 35,000ft. is a brush with death for any man should the oxygen supply be interrupted. Higher than that there must ensue a fight to retain consciousness. Paralysis attacks the legs and arms. The stomach is painfully distended. Finally, there comes the awful penalty of height, "the bends."

No one who has ever gone through an attack of the "bends" has been able adequately to describe his suffering. It is an excruciating pain in the joints, shoulders, elbows, knees, ankles. It leaves the victim in a state of nervous collapse.

Day after day Reynolds went up.

After the first Ju 86 was destroyed another appeared, but flying higher than ever. The maintenance crew on the airdrome worked on the Spitfires to give them yet greater height.

Twenty-one Hours' Swim

The other two test pilots, Genders and Gold, one day intercepted the enemy. They were seen and he instantly made out to sea as fast as he could go. Genders realised that he must run out of petrol before long. In fact, he had only five gallons left when he closed sufficiently to attack, but he punctured the pressure cabin and so forced the Ju 86 down, after which Gold got within range.

There ensued an extraordinary dog-fight, far out over the Mediterranean, for while the Spitfire was fast, the Ju was manœuvrable. Gold shot down the enemy aircraft and returned to his airdrome with only two gallons of petrol to spare.

Meanwhile, Genders had run out of fuel and was trying to glide home. From 45,000ft. an aircraft can glide a long way, and he thought he might make it. He was half-way back when he passed over two small ships and he could easily have baled out after firing distress flares with a certainty of being picked up from the sea. He had no dinghy, since this extra weight was regarded by the test pilots as an expensive luxury, but he decided to continue gliding in an effort to get his valuable aircraft home.

The effort was in vain. Genders was forced to bale out at 1,000ft. when he was still forty miles from the Egyptian coast, and fell in the sea at one o'clock in the afternoon. He began to swim and continued doggedly for the next twenty-one hours. By the direction of the wind, which is generally on-shore, he thought he was going in the right direction and once actually spotted the coast, but was carried out again by the Nile stream. Nevertheless, he carried on and finally walked ashore, to the astonishment of two gentlemen who were engaged in duck-shooting.

His clothes were rotted by the sea, and he was forced to borrow a native galabieh, in which he returned to his home airdrome, but apart from painfully sore eyes he suffered no ill-effects from his long immersion.

Now the battle for height became so intense that Reynolds, in pursuit of the last Ju 86s, had to climb to nearly 50,000ft. The temperature within the cockpit fell to 67 degrees below zero. Perspex, instruments, control column, all became coated in ice.

Fighting faintness and nausea, almost blind from weakness and pain, desolated by a sense of loneliness, Reynolds struggled on until suddenly the enemy aircraft appeared before him less than 100 yards away. He tried to fire his guns, but his arms were paralysed and the German quickly turned out to sea.

Reynolds had been up above 45,000ft. for over an hour, but steering the aircraft by manipulating his weight, he followed the Junkers far out over the Mediterranean and finally freed his frozen hands sufficiently to join combat and fulfil his purpose. Then he turned for home.

For the Spitfire to attain such heights in this climate is extraordinary. It has climbed many thousands of feet above the ceiling for which it is designed. Its control in such circumstances is a matter of the utmost hazard, and the faintest error in judgment would be fatal.

Absolute Horizon

Gliding home to save fuel, Reynolds was able to observe a sight vouchsafed to few men. From an altitude of eight or nine miles he could look over his shoulder at the whole of the Aegean Sea. Crete lay below like a pebble in a puddle. On his right he could see beyond Benghazi into the Gulf of Sirte and, on his left, over the entire length of Palestine to the mountains of Lebanon. Before him the Egyptian coast, 100 miles distant, appeared a hand's breadth away, and he could survey the whole of the delta to beyond Cairo. In one glance the length of the Suez Canal was revealed from the Mediterranean to the Red Sea.

Flying Officer Reynolds returned to his base three hours after the Sea Rescue boats had set out to look for him.

The Ju 86 can no longer fly over Egypt unscathed. Vital information has been denied to the enemy.

Flying Officer Reynolds has been awarded the Distinguished Flying Cross.

REDUCING TO PRODUCE

(*Continued from page 611*)

where shorter lengths are required. The discarded parts of the pipes are then unravelled into their various components and sent for salvage in this form. Metal tubes are also tested under pressure and checked for shape against templates before being marked with their part numbers.

Nothing is wasted. Even bins of tiny nuts and bolts are sorted by ingenious grading machines, themselves built out of scrap.

So it goes on through the whole depot; clever improvisation of salvaged material to test other salvage; a thrifty eye kept on any piece of fashioned material which may save a few precious wartime man-hours, and a rigid collection of even the most hopeless-looking scrap for remelting or for processing in some manner in order that it may again take its part in war production. There is, as already indicated, a ruthless rejection of anything which is not up to the highest standard required in the construction of machines capable of preserving the very high "Bristol" tradition for quality. Even then it is amazing to the visitor to see what care and method are able to salve from the heaps of wrecked material which are submitted for the attention of the Bristol Salvage Depot; in fact, an enquiry as to what the possibilities were regarding an apparently hopeless-looking heap of "junk" evoked the reply that probably 20 per cent. would be salvaged for further service.

WHITHER NEXT?

Air Power Policy in the United Nations' Offensive : Easterners and Westerners : Northerners and Southerners

By MAJOR F. A. de V. ROBERTSON, V.D.

ADMIRALS, GENERALS and AIR MARSHALS are justifiably contemptuous of the armchair strategist. Yet, as those exalted officers are debarred from telling the world all that they know, the ordinary newspaper reader would find life very dull in time of war if armchair strategists did not give him something to think about, some ideas to consider in his own armchair and to adopt or reject.

The present stage of the war, with the United Nations everyhere turning from defence to aggression, gives a better excuse than usual for the amateur student of war to speculate in print on what Britain and America ought to do next. The parts to be played by Russia and China have been laid down for them; it is theirs to press their enemies back from their territories and damage them as much as possible in the process. Britain and America are already invading territories in the hands of Axis powers, and when their immediate conquests have been completed a choice lies before them as to where next they shall strike at the enemy.

It is proposed to leave the Pacific campaign out of account for the present, and to confine speculation and suggestion to Europe and the Middle East.

In the last war there were two schools of strategic thought, known as the Westerners and the Easterners. The former held that the royal road to victory was to fight the German armies in the West, because once the German military power was broken everything else would necessarily follow. The Easterners held that the wisest course would be to work round the flank of the Central Powers and attack them in the rear, that is to say, in the area which was once called the Near East and is now called the Middle East. We may recall that the present Prime Minister was an Easterner, for it was he who, as First Lord of the Admiralty, initiated the first attack on the Dardanelles, which led to the Gallipoli campaign. That campaign failed, while in the end the German army in the West was broken and defeated. Yet the controversy still goes on, and will probably be discussed by generations still unborn, as to whether that victory in the West was not bought at far too high a cost in the lives of British and French soldiers, and whether a resolute adoption of the Easterners' plan would not have won the war much more cheaply and much more quickly.

Mediterranean Springboard

Now another somewhat similar controversy has arisen, whether to invade the Continent in the North, with Great Britain as a base, or in the South, with the base in North Africa. It is, most probably, only a controversy among the armchair strategists and newspaper readers. We may all guess that Mr. Churchill and President Roosevelt have a shrewd idea of what they intend to do.

One hint has been given from the higher authorities—perhaps we may say from the War Cabinet—for Mr. Attlee, the Deputy Prime Minister, is reported to have said recently in a speech at Reading: "We have made the Mediterranean not only safe, but I hope we shall soon go beyond that and make it a jumping-off place for a great offensive." In addition, Field Marshal Smuts long ago expressed the opinion that the Mediterranean was the crucial area in this war—if I remember right, he said that Armageddon would probably be fought there—and he has more or less expressed the same sentiments several times since. There are, however, voices still heard which express the belief that the great invasion must take place in the North.

So in this war we have a controversy, not between Westerners and Easteners, but between Northerners and Southerners. In addition to that there is another controversy, namely about the part to be played in the great offensive by air power.

Put succinctly, the question is whether the main British and American effort in the near future should be concentrated on bombing German production with the aim of weakening German resistance when the invasion by the Allies takes place, or whether the main air effort should be directed to assisting the Navy and the Army in an actual invasion in the near future.

Professional as well as amateur strategists are handicapped by the fact that this is the first war in which air power has been a serious factor. There are really no precedents to guide anyone. The Air Staff and the Air Staff College at Andover have been considering the question all through the inter-war years, but their studies have of necessity been mainly academic. They cannot refer to what use Marlborough or Napoleon or Belisarius made of his aircraft.

Douhet Disproved

Those who have tried to study the mind of the Air Staff between 1919 and 1939 have noticed some apparent changes of doctrine. There was a period when fighter aircraft were definitely depreciated (probably because at the time they were technically underdeveloped in comparison with the bombers of the day), and the doctrine was loudly expressed (not, of course, by members of the Air Staff, but by some who claimed to speak with authority) that there was no real defence against air attack; all that could be done was to bomb the enemy harder than he bombed you until he squealed for mercy.

It was also commonly said at that time (definitely not by the Air Staff, which may have disagreed) that "striking at nerve centres"—i.e., bombing residential areas—would be the surest way of beating an opponent to his knees. Well, we have learnt that British fighters can at least defeat day attacks by German bombers, and we have also seen that even ghastly destruction in residential areas has not driven the British, the German or the Russian people to clamour for surrender. It remains to be seen what the repercussions in Italy will be to the havoc in Genoa and Turin; but the mass of the Italian people has little heart in the war, and if it importunes Mussolini to give them peace at any price, that will prove but little.

One remembers, too, the long period in which the Air Staff displayed, not in words but by its actions, what little confidence it reposed in torpedo aircraft. All through that period the Admiralty clung to its belief in the air-borne torpedo, and insisted on keeping torpedo-bomber squadrons in its carriers. Now Beauforts and Hampdens are visible proofs of the conversion of the Air Staff.

These points are mentioned to illustrate the difficulties under which the Air Staff has laboured in trying to formulate theories with no precedent to guide it. Precedents are being created now by the method of trial and error, and future generations will have the advantage of being able to study the war which began in 1939.

At the end of this war it will probably be possible to assess the precise value of Bomber Command's campaign against German production. At present we must admit the force of the plea that the Command has never been given a completely free hand. It has had to send many bombers overseas and also to divert its energies frequently to active assistance for the Navy (e.g., Brest) and the Army (e.g., Dieppe). Even if the production of bombers were ten times what it is, the Command would have had to do the same things, and no doubt it would have com-

WHITHER NEXT?

plained that it was being left short. No one ever has enough of aircraft or of anything else in war.

In spite of the lack of precedent in air warfare, certain principles may be accepted as basic because, while weapons change and tactical methods change with them, the principles of warfare do not change. One of these principles is that while a battle on sea or on land is in progress (and battles may last for months), no force of aircraft which can help either the Navy or the Army to win that battle ought to be diverted to any other object.

Battle Support Urgent

The long-drawn struggle along the immense Russian front may be considered for this purpose as one battle, and a battle vital in its effect on the war. While that has raged neither *Luftwaffe* nor Red Air Fleet has indulged in any large-scale independent operations. The present Battle of the Mediterranean is also probably vital, and when an invasion of the Continent takes place it will involve a series of vital battles.

At such crises the long-view plan of attacking production must give way to the immediate need of attacking the enemy's supply lines and his fighting troops. It would only be justifiable then to send bombers against production centres if those particular bombers were of a class which was not very effective for Army purposes. It would be unsound to think about winning possible battles a year or two years hence if by so doing one risked losing what might be a vital battle to-day. The War Cabinet throughout this war has shown that it appreciates this principle, and has rightly used Bomber Command as a reserve, a very flexible reserve, for reinforcing efforts by the Navy and the Army whenever the need has arisen. Striking at production is only legitimate in intervals between battles.

To return to the question of North or South, the Anglo-American command is now keeping Hitler guessing. He has obviously weakened his defence forces in northern Europe so as to set up a defence line along the Riviera. That might be a reason for springing a surprise in the North. But the fortifications there still remain, and they have been consolidated for nearly three years.

Germans and Italians are doubtless digging like fury all the way from the Gulf of Genoa to the Pyrenees, but they cannot in a few weeks establish a line comparable in strength to that which is the result of three years' work in northern Europe. If all goes according to our hopes and the whole northern shore of Africa falls into Allied hands, we shall possess a number of ports and air bases of the utmost value for an attack on southern Europe.

Italian Fleet Problem

It will first be necessary to deal with the Italian fleet. That fleet has not done much fighting, and when it has ventured into the open Mediterranean it has not exactly covered itself with glory. But it remains a fleet in being, and it cannot be disregarded. Some good naval authorities have written that Italy's naval policy has been correct, in that she has kept her capital ships as safe as possible. They tie up a British fleet; for if the British War Cabinet were to send our capital ships away, say against the Japanese, the Italians would immediately assume command of the Mediterranean.

It is probably impossible for British surface warships or submarines to deal with the Italian fleet while it stays in well-defended harbours. The problem seems one for aircraft to solve if they can. At any rate, it is an utter mistake to imagine that Italy is such a minor factor in this war that it would be waste of time and effort to knock her out.

Everybody has been told many times, and only the most obtuse can have needed the telling, that Britain's war effort, and America's too, depends on shipping. It has been an enormous strain on the shipping position to have to supply the Middle East by the route round the Cape. To set free the Mediterranean for British cargo ships would almost be the equivalent of sinking large numbers of submarines or obliterating a factory where U-boats are assembled.

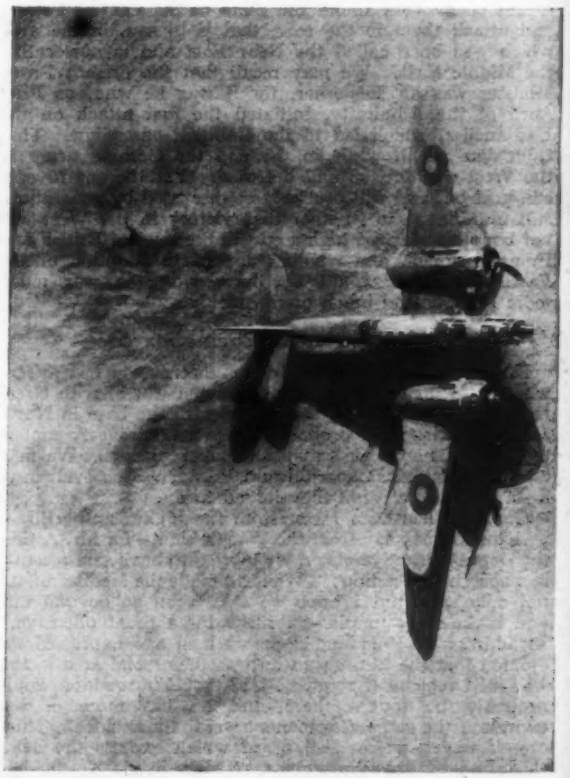
I write "almost" because the destruction of submarines and their nests is certainly more important than outbuilding the U-boats and their sinkings. The setting free of the ships hitherto tied to the voyage round the Cape would rather resemble a huge building effort by Allied shipyards. But, again, those vessels cannot freely use the Mediterranean until all danger from the Italian fleet has been removed. As we have ourselves demonstrated in the Mediterranean, many submarines and aircraft may only make a limited impression on a well-conducted convoy, but a fleet which is superior to the escort can blow the whole convoy to pieces in a very short time.

The immediate object after securing the whole African coast ought, it seems, to be a great naval and air offensive against the Axis in the Mediterranean. It should be worth while sending an overwhelming force of heavy bombers with all their cumbrous ground equipment into Africa. The help of the Army is not excluded, for Combined Operations are the order of the day.

We might conceivably copy the Japanese methods in the Pacific and occupy island after island—Pantellaria first, and then why not Sicily, Sardinia and Corsica? The Germans would still have had scant time to make the whole Riviera impregnable—if any long coast line can be made impregnable. This is no time to halt and see whether the bombing of Germany is really hamstringing the German armies, and to calculate now many tons of bombs dropped by how many aircraft on how many nights would accomplish that object.

> "There is a tide in the affairs of men,
> Which, taken at the flood, leads on to fortune;
> Omitted, all the voyage of their life
> Is bound in shallows, and in miseries."

Let the United Nations not miss that tide.



IN FINE PITCH: A Martin Baltimore taking off from a desert airfield.

AIRCRAFT NOISE

An Outline of the Problem of Noise Reduction in Aircraft

By
D. C. GREENWOOD,
A.M.Inst.B.E.

MUCH has been done since the early days of the cotton ear plug towards defeating the deafening roar which relentlessly enveloped the unhappy air traveller from take-off to touch-down. Nowadays it is, indeed, frequently the case of "Quiet, please," for air-line passengers in order that those sleeping shall not be disturbed! From a military point of view, however, where the aircraft as a war machine is necessarily stripped of all refinements and luxuries, noise is one of the first demons to reappear. The extent to which noise proofing might be considered a luxury must be carefully considered.

Great pains are taken to give bomber crews as much comfort as practicable. Long flights over enemy territory, when the crews must be ever vigilant, demand a maximum of physical efficiency, and any property which detracts from this efficiency must be considered with great care and shrewd judgment. The question to be answered in an aeronautical problem is usually, "What is the most efficient compromise?" It is so in the case of the fight against noise. In order that this question of noise might be answered, scientific reasoning and methods must be applied both during the design stage and after. It is the purpose of this article to indicate broadly what lines are followed and what problems are involved.

The Nature of Sound

The first requirement is, of course, a knowledge of the nature and measurement of sound. It is a common experience that the source of sound is usually a vibration. To arrive at some analogy let us imagine a quantity of stones thrown into a pond at constant intervals. They will cause waves to spread out from the centre of the splash. As each stone falls, it will create a new wave-crest, and if the stones were dropped at the rate of one every second then the wave could be said to have a "frequency" of one wave-crest per second.

In the case of a tuning fork, an analogous phenomenon takes place. The prongs vibrate and cause waves to be spread out in the air which are perceived by the ear as a sound. The frequency of the sound wave is equal to the number of times which the prongs vibrate per second, and is said to be so many "cycles" per second; or the frequency of a tone is the number of complete cycles of pressure per second, and is the physical characteristic of the tone. The "pitch" of a tone more or less corresponds to the frequency, and the B.S.I. (1936) definition of a pitch interval is:—

> "The pitch relation of two tones measured either as the ratio of their frequencies or in terms of the logarithm of that ratio."

It is not, however, strictly correct to identify pitch intervals with frequency ratios, for it has been shown (Ref. 1) that pitch (which is a subjective quality) depends to some extent upon the loudness of a tone as well as the frequency.

Frequency and Pitch

With the above proviso, then, a pitch interval which corresponds to a frequency ratio of 2 to 1 is known as an "octave." Middle C on a piano corresponds to a frequency of about 260 cycles, but scientists usually use a figure of 256 cycles per second for middle C, which is then eight octaves above one cycles per second. The audible range of frequencies in air is roughly from 15 cycles to 20,000 cycles; the audible wavelengths being between 2,300 cm. (75.4ft.) and 1.7 cm. The highest note of a piano is about 4,600 cycles, and the lowest 30 cycles.

The Velocity of Sound

The velocity of sound is entirely independent of the frequency. If c is the velocity of propagation of a wave, then for sound propagation in a gas:—

$$c = \sqrt{\frac{\gamma . P}{\rho}}$$

where P is the pressure,
γ is the ratio of the specific heat at constant pressure to that at constant volume,
and ρ is the density.

The velocity, therefore, varies with the temperature, since ρ varies with the temperature.

If the velocity at o° Centigrade is c_0, and the velocity at t° C. is c, then approximately:—

$$c = c_0\sqrt{1 + \frac{t}{273}}$$

c_0 is here approximately 33,130 cm. per second.

At t° C. the velocity of sound in air may be found more conveniently if the above expression is rewritten:—

$$c = 33{,}130 + 61.t \text{ cm. per second.}$$

The velocity of sound in air at normal temperature and pressure (15° C. and 76 cm. of mercury) is thus 34,050 cm. per second, or about 760 miles per hour.

An expression for wave propagation in any medium is:—

$$c = \lambda . f$$

where f is the frequency,
and λ is the wavelength.

Intensity—Noise Levels

Now, returning to the tuning fork, if the prongs are tapped harder, more energy will be imparted to the vibrational motion, and the sound will be perceived by the ear as being louder; or the "intensity" will be greater. Now, since the intensity is measured in watts per sq. cm., and audible sound intensities range from about 10^{-16} watts per sq. cm. to about 10^{-2} watts per sq. cm., it is more convenient to express intensity measurements logarithmically. The logarithmic measure is expressed in "decibels."

The decibel first came into use in telephony as a means of expressing conveniently the ratio of two different values of electrical quantities. If I_1 and I_2 are two intensities, they differ by n decibels where:—

$$n = 10\text{Log}\frac{I_1}{I_2}$$

It must be carefully noted that the decibel is simply the logarithm of a ratio and not a unit. Thus, it is always necessary to state from what datum intensity the number of decibels is reckoned. The datum level usually used is that of threshold intensity. As a rough indication of the magnitude of the smallest change of intensity that can be detected by the ear, a figure of 1 decibel may be taken. Under experimental conditions, however, a change as low as 0.1 decibel may be detected.

Threshold Intensity

The ear is an extremely sensitive instrument and many experiments have been conducted in an effort to arrive at a figure which will represent the threshold of hearing. This threshold varies with the frequency of the tone, and threshold intensity has been chosen by the B.S.I. as that of a 1,000-cycle note having an intensity of 10^{-16} watts per sq. cm., and in the decibel scale zero decibels is usually fixed to coincide with the threshold of hearing at 1,000 cycles.

REFERENCE

1) Loudness, Pitch and Timbre of Musical Tones and their Relation to the Intensity, the Frequency and the Overtone Structure. H. Fletcher. *Journ. Acoustical Soc. Am.* (1934).

AIRCRAFT NOISE

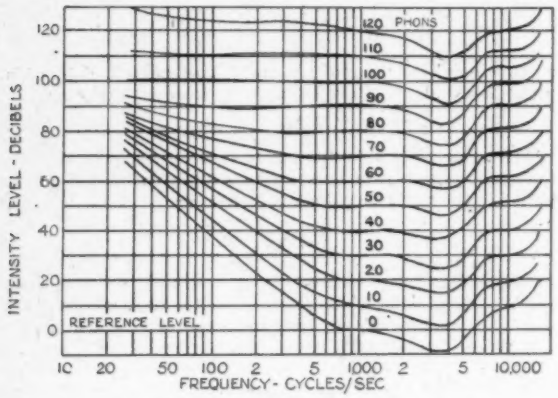


Fig. 1. Loudness contours.

Fig. 1 shows how loudness levels vary with frequency. A 90-cycle note at 40 decibels is seen to sound equally loud to a 400-cycle note at 10 decibels.

The unit known as the "phon" has been used to indicate loudness levels, since the decibel is not a physical quantity but simply a ratio. In other words, when the decibel zero is used to indicate threshold intensity this value corresponds with zero phons. Table 1 gives some idea of the noise levels in phons in various situations. In considering the phon scale, however, it should be borne in mind that the actual sensation of loudness is not proportional to the number of phons.

From the table it will be seen that the almost painfully loud noise of two circular saws at 3ft. is 110 phons, which is less than twice the number of phons of ordinary conversation at 3ft. It must be remembered that the phon scale is based on the decibel scale, which in turn is logarithmic. The actual loudness of a 1,000-cycle tone is approximately proportional to the 4th power of the number of phons. Fig. 2 shows the relation between loudness and phons. Thus in terms of the actual sensation of loudness the two circular saws are about six times as loud as conversation.

Noise Meters

There are two types of meters utilised in measuring and recording sound levels, namely, the subjective type and the objective type. The subjective type may be described as the type of meter which assesses noise levels by aural comparison. In other words, a noise level is produced by an audiometer and this level is compared with the noise to be measured. This type of meter has the advantage of being very simple and easy to use.

The objective type, however, measures physically some function of sound pressures and frequencies that is an adequate approximation in magnitude to the resulting sensation of loudness. From an engineer's point of view the latter type of meter is preferable. The objective meter consists basically of a microphone, amplifier, and detector, the last named indicating the noise level in decibels or phons.

Fig. 2. (Right) Relation between loudness and phons.

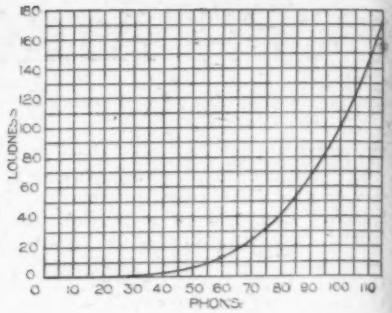


Fig. 3. (Below) Typical analysis of noise levels inside an aircraft.

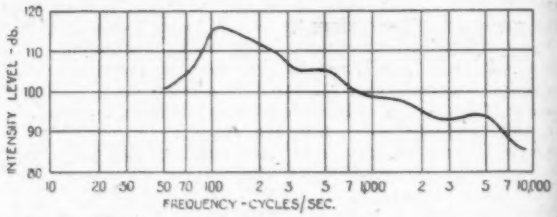


Table I.—Noise Levels in Various Situations.

Two circular saws at 3ft. distance	110 Phons.
Power station pump house	102 "
Machine room	100 "
Boiler factory	97 "
Busy street, trams passing	85 "
Very noisy restaurant	70 "
Office on busy street, window shut	60 "
Moderate restaurant clatter	50 "
Street in residential district, day	50 "
Ticking of a watch at 3ft.	30 "
Average whisper 4ft. away	20 "
Rustle of leaves in gentle breeze	10 "
Range of speech in normal conversation	35–65 "
Ordinary conversation at 3ft.	65 "

Now, so far only pure tones have been discussed, but the noise produced by an aircraft has a very complex spectrum. There is also the phenomenon of "masking" to be considered. In general the lower frequencies—which predominate in aircraft—have the power of masking the higher frequencies; thus speech, which contains frequencies at about 120 to 8,000 cycles, is easily masked. It is desirable, then, that the noise produced by an aircraft should be analysed, if possible. This is most effectively accomplished with the use of an objective noise meter and octave filter which can be arranged to pass only those frequencies occurring in a certain band, thus enabling the whole spectrum to be explored. Fig. 3 shows a typical analysis of the noise levels inside an aircraft.

(To be concluded next week.)

OBJECTION OVERRULED

Lord Trenchard Redcaps the Lot

DURING his visit to the Allied Air Forces in the Western Desert, Marshal of the Royal Air Force Lord Trenchard delighted the fighter pilots with some excellent stories of the earlier days of the Service. One, in particular, deserves to be retold.

Just after the last war Lord Trenchard had the task of giving titles to the various commissioned ranks in the R.A.F. He drew up the list of ranks as they are now used—Pilot Officer, Flying Officer, and so on—and they were submitted to the Government for approval.

There were objections, however, from the War Office to the use of the term "Marshal" in the rank of Air Marshal, and from the Admiralty to the use of "Commodore" in the rank of Air Commodore. Much correspondence developed, and at last Mr. Lloyd George set up a Cabinet committee to discuss the subject, the chairman being the then Mr. Stanley Baldwin, Chancellor of the Exchequer.

A well-known Army officer started the discussion on the title of Marshal. He claimed that it was wrong to degrade this great word by applying it to a comparatively low rank. "Marshal of France," he declaimed, "Field Marshal of the British Empire."

"And, Mr. Chairman," interposed Lord Trenchard, "Provost Marshal!"

Service Aviation

ONE MORE READY : Towing a Stormovik dive-bomber out on the tarmac for its first flight.

Royal Air Force and Fleet Air Arm News and Announcements

Promotions

The London Gazette, November 17th, 1942.

GENERAL DUTIES BRANCH.

Air Comdre. J. W. JONES, C.B., to be Act. Air Vice-Marshal. November 10th, 1942.

Air Comdre. W. B. CALLAWAY, A.F.C., to be Act. Air Vice-Marshal. November 25th, 1942.

Grp. Capt. (Act. Air Comdre.) F. F. INGLIS to be Act. Air Vice-Marshal. October 19th, 1942.

The London Gazette, November 24th, 1942.

GENERAL DUTIES BRANCH.

Air Cmdre. T. A. LANGFORD SAINSBURY, O.B.E., D.F.C., A.F.C., to be Act. Air Vice-Marshal, November 16th, 1942.

TECHNICAL BRANCH.

Air Cmdres. to be Act. Air Vice-Marshals, October 24th, 1942 :—

O. G. W. G. LYWOOD, C.B.E.

R. S. AITKEN, C.B.E., M.C.

Awards

THE KING has been graciously pleased to approve the following awards in recognition of distinguished services in the campaign in the Middle East :—

KNIGHT GRAND CROSS OF THE BATH.

Air Chief Marshal Sir A. W. TEDDER, K.C.B., C.B.

KNIGHT COMMANDER OF THE BATH.

Air Vice-Marshal A. CONINGHAM, C.B., D.S.O., M.C., D.F.C., A.F.C.

KNIGHT COMMANDER OF THE BRITISH EMPIRE.

Air Vice-Marshal K. R. PARK, C.B., M.C., D.F.C.

Air Vice-Marshal L. H. SLATTER, C.B., O.B.E., D.S.C., D.F.C.

COMPANION OF THE BATH.

Air Vice-Marshal G. G. DAWSON, C.B.E.

Fleet Air Arm

THE KING has been graciously pleased to approve the following awards for gallantry, skill and devotion to duty in air operations in the Middle East.

BAR TO THE DISTINGUISHED SERVICE CROSS.

Temp. Sub. Lt. (A) E. SERGEANT, D.S.C., R.N.V.R.

DISTINGUISHED SERVICE CROSS.

Lt. (A) K. H. GIBNEY, R.N.

Temp. Sub. Lt. (A) D. R. FOSTER, R.N.V.R.

Temp. Act. Sub. Lt. (A) N. C. M. COOPER, R.N.V.R.

Temp. Sub. Lt. (A) B. WHITE, R.N.V.R.

DISTINGUISHED SERVICE MEDAL.

Act. Petty Officer (A) F. W. HAZELDINE.

Air Marshal Sir William Laurie Welsh, K.C.B., D.S.C., A.F.C., who is in command of the R.A.F. with the First Army in North Africa.

MENTION IN DESPATCHES.

Lt. (A) F. A. SWANTON, D.S.C., R.N.

Temp. Sub. Lt. (A) D. R. FOSTER, R.N.V.R.

FOR skill and resource in action against enemy submarines while serving in H.M. Naval Aircraft :—

MENTION IN DESPATCHES.

Sub. Lt. (A) D. J. COOK, R.N.

Temp. Sub. Lt. (A) P. A. JORDON, R.N.V.R.

Royal Air Force

THE KING has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations :—

DISTINGUISHED SERVICE ORDER

Act. Wing Cdr. J. D. D. COLLIER, D.F.C., R.A.F.O., No. 97 Sqn.—This officer already holds the D.F.C., which was granted to him for his part in the bombing of Bordeaux, and a bar to the D.F.C. for his gallantry in a daylight raid on Brest. Since these awards Wing Cdr. Collier has participated in further operational sorties, and his leadership and conduct have been exemplary.

Act. Wing Cdr. A. G. S. COUSENS, D.F.C., No. 115 Sqn.—By his untiring efforts as navigator and his terrific keenness to press home the attack, this officer has contributed in a large measure to the success achieved by his squadron. He is a fine squadron commander, who has raided many of the highly important industrial targets in enemy territory.

Act. Sqn. Ldr. A. S. H. E. ENNIS, D.F.C., R.A.F.V.R., No. 158 Sqn.—This officer has completed many operational sorties. There are very few targets in Germany which have not suffered as a result of his remarkable spirit of determination to achieve his objective. In February, 1941, he was employed on a special mission to Malta, which he accomplished with complete success, and in May, 1942, he was awarded the D.F.C.

Act. Sqn. Ldr. R. S. GILMOUR, D.F.C., R.A.F.V.R., No. 7 Sqn.—Sqn. Ldr. Gilmour has completed many major operational sorties since he was awarded the D.F.C. He has an outstanding record as an operational pilot, his attacks, even on the heaviest defended targets, have been pressed home with the greatest determination and skill. He has also attacked such distant targets as Pilsen and Turin.

BAR TO DISTINGUISHED FLYING CROSS

Act. Wing Cdr. K. W. KAUFMANN, D.F.C., R.A.F.V.R., No. 142 Sqn.—By his fearless determination and complete disregard of enemy opposition Wing Cdr. Kaufmann has set an inspiring

SERVICE AVIATION

example to his crews. On one occasion, when alone over a heavily defended area of the Ruhr, he was caught in a cone of searchlights and his aircraft was hit in several places by anti-aircraft fire. Skilfully extricating himself with great determination, this officer penetrated farther into the enemy's territory and bombed his target.

Act. Sqn. Ldr. W. D. B. RUTH, D.F.C., No. 207 Sqn.—This officer's operational sorties have included a large number of attacks on heavily defended targets. At all times he has shown outstanding courage and devotion to duty.

DISTINGUISHED FLYING CROSS.

F/O. F. H. MITCHELL, R.A.F.V.R.—This officer is a highly skilled observer. He has participated in many sorties at night, and his fine work has assisted in the destruction of two enemy aircraft.

F/O. J. P. RICKARDS, R.A.A.F., No. 55 Sqn.—This officer has completed numerous sorties, involving reconnaissances, shipping and anti-submarine patrols. On one occasion in May, 1942, F/O. Rickards was wounded during a sortie. Despite this, he flew his aircraft safely back to base in difficult circumstances.

P/O. R. G. LARGE, R.A.F.V.R., No. 616 Sqn.—One day in October, 1942, P/O. Large was one of two pilots whose aircraft were intercepted near the coast in Northern France by enemy fighters. In the ensuing engagement P/O. Large destroyed a Fw 190. His fellow-pilot, however, was forced to leave his aircraft by parachute, but he descended safely on to the sea a few miles from the enemy's coast. P/O. Large, having expended all his ammunition and running short of petrol, flew on to an airfield in this country, where he landed and refuelled. Without waiting for his aircraft to be rearmed he took off, determined to locate his comrade. In this he was successful, and he continued to fly over the spot until his colleague was picked up by a rescue launch. On the return flight P/O. Large skilfully eluded enemy fighters which attempted to attack him.

W/O. A. C. BRAY, R.N.Z.A.F., No. 142 Sqn.—W/O. Bray has completed many sorties over enemy territory. On one occasion in October, 1942, he captained an aircraft detailed to attack a strongly defended target in Western Germany. In spite of heavy anti-aircraft fire and searchlight activity W/O. Bray attacked his objective successfully from a low height; he also secured an excellent photograph of the target.

Wing Cdr. E. C. EATON, No. 101 Sqn.—Before taking command of his squadron, Wing Cdr. Eaton proved himself a very capable operational captain and flight commander. He has taken part in attacks against such distant targets as Genoa and Stettin.

Act. Sqn. Ldr. J. H. KIRKPATRICK, R.A.F.V.R., No. 78 Sqn.—Sqn. Ldr. Kirkpatrick is a determined and courageous captain of aircraft. As flight commander in this squadron, he has fostered morale and spirit in the crews, and has won the respect and confidence of all.

Act. Sqn. Ldr. J. D. PATTISON, R.C.A.F., No 419 (R.C.A.F.) Sqn.—Sqn. Ldr. Pattison has at all times displayed great zeal for offensive operations. On one occasion he brought his aircraft 120 miles across the North Sea on one engine and made a perfect landing.

Flt. Lt. J. C. CARRIERE, No. 140 Sqn.—This officer for the past six months has commanded a flight. Although some of his missions have been undertaken in appalling weather, Flt. Lt. Carriere has always pressed on to achieve his purpose.

Flt. Lt. C. E. KNOWLES, No. 140 Sqn.—This officer has always displayed courage and determination in the face of the enemy. His splendid leadership and untiring efforts have produced outstanding results in the many missions on which has has been engaged.

Naval Base Attack

Flt. Lt. D. PETLEY, R.A.F.V.R., No. 35 Sqn. (since reported prisoner of war).—This officer has always shown outstanding keenness to proceed on operations over Germany, and his captaincy has been of the highest standard. He has attacked some of the enemy's most heavily defended targets and executed a low-level attack at 150 feet on the German naval base at Trondheim, in the face of intense opposition.

Act. Flt. Lt. V. G. J. AGUTTER, R.A.F.V.R., No. 158 Sqn.—Flt. Lt Agutter has made many sorties over enemy territory, taking part in such successful raids as those on Lübeck, Rostock, Cologne, Hamburg and Dusseldorf, and producing some excellent photographs. On two occasions, by his skill and ability, he has brought a damaged aircraft safely back to base.

Act. Flt. Lt. C. H. BOOTHMAN, R.A.F.V.R., No. 44 (Rhodesia) Sqn.—This squadron gunnery leader has at all times shown an exceptional keenness to fly on operations, and by his courage and coolness in action has set a fine example to his colleagues.

Act. Flt. Lt. H. S. GRIFFITHS, R.A.F.V.R., No 214 (F.M.S.) Sqn.—This officer, by his outstanding ability as squadron gunnery leader, has on several occasions successfully put out of action searchlight positions and silenced guns which were engaging his aircraft. Flt. Lt Griffiths has always volunteered for the most difficult and dangerous tasks and has displayed, in the face of the enemy, a coolness and courage which have been the admiration of all.

Act. Flt. Lt. B. N. JOST, R.C.A.F., No. 419 (R.C.A.F.) Sqn.—Flt. Lt Jost has displayed

CO-OPERATION IN MALTA: The Army and Navy help the R.A.F. to refuel and re-arm a tropicalised Spitfire. The blast protection walls are made of four-gallon petrol tins filled with earth.

courage and determination in his operational sorties against the enemy, and while acting as Flight Commander has set an inspiring example to those subordinate to him.

Act. Flt. Lt. V. C. MCAULEY, R.C.A.F., No. 7 Sqn.—Flt. Lt. McAuley is an outstanding navigator, whose ability to fly straight to the most distant targets under difficult conditions is exceptional.

Act. Flt. Lt. J. W. MENZIES, R.A.F.V.R., No. 101 Sqn.—Throughout the time he has served in this Squadron, Flt. Lt. Menzies has been responsible for promoting a very high standard of keenness and efficiency.

Act. Flt. Lt. J. H. ROBINSON, R.A.F.V.R.—Flt Lt. Robinson has been employed as station navigation officer since December, 1941. Throughout this officer has done magnificent work in educating navigators to a very high degree of efficiency, working long hours uncomplainingly. During subsequent long and arduous periods of operations he was on duty many nights in succession.

Lübeck at 800ft.

Act. Flt. Lt. P. J. STONE, R.A.F.V.R., No. 50 Sqn.—Flt. Lt. Stone has a long record of successful operational sorties. He participated in the raid on Lübeck in March, 1942, circling the target three times before dropping his incendiaries in the middle of the target area, from a height of only 800 feet. Subsequently, this officer has taken part in the majority of the heavy attacks on the enemy's most highly defended territory.

F/O. J. T. CHRYSTAL, R.A.F.V.R., No. 44 Sqn.—This officer has always shown the greatest coolness and deliberation, both in planning and executing his raids. On one occasion during a daylight attack, his rear gunner, although wounded, was enabled to shoot down an enemy fighter through the skilful evasive tactics displayed by F/O. Chrystal.

F/O. B. CLITHEROE, R.A.F.V.R., No. 207 Sqn.—This officer is an exceptionally keen, skilful and reliable operational navigator. In July, 1942, he was detailed to attack the shipbuilding yards at Danzig. Despite exceptional conditions of cloud and severe icing, F/O. Clitheroe succeeded in locating the target, which was successfully bombed from 1,000 feet.

F/O. E. K. CRESWELL, R.A.F.V.R., No. 158 Conversion Flt.—This officer has shown the utmost tenacity and determination in reaching his objectives, which have been most of the well-known targets in Germany, including Berlin. He has also bombed Turin successfully. On two occasions, by his skilful airmanship he has brought home, and successfully landed, a badly damaged aircraft.

F/O. P. HEYWOOD, R.A.F.V.R., No. 7 Sqn.—This officer is a skilful captain of aircraft. He shows the keenest enthusiasm and determination, pressing home his attacks against the fiercest opposition.

F/O. J. HODGSON, R.A.F.V.R., No. 83 Sqn.—This captain of aircraft has taken part in attacks on the majority of the most heavily defended targets in Germany, including a daylight attack on the submarine building yards at Danzig. On this occasion F/O. Hodgson attacked from low level after flying several hundred miles in appalling weather.

F/O. H. B. MARTIN, R.A.F.V.R., No. 50 Sqn.

F/O. J. F. LEGGO, R.A.A.F., No. 50 Sqn.—These two officers have flown together as captain and observer respectively of an outstandingly successful and efficient crew, who have consistently bombed the targets from a low altitude, returning with excellent photographs. On one occasion in August they spent 30 minutes locating the target in the face of intense opposition. The aircraft was hit in many places, and one engine caught fire; nevertheless, the attack was pressed home in the most resolute and determined manner. Again in August they were detailed for a mission calling for a high standard of navigation and crew co-operation, which was accomplished in a highly successful manner.

F/O. O. H. MORGAN, R.C.A.F., No. 150 Sqn.—F/O. Morgan has participated in attacks on some of the most heavily defended targets. Despite being seriously handicapped by air sickness, and being involved in two severe crashes, his morale has remained unshaken, and his determination has never wavered. This officer has frequently brought his crew back safely to base through extremely bad weather, with the aircraft damaged and the wireless unserviceable.

F/O. F. A. ROPER, R.C.A.F., No. 207 Sqn.—F/O. Roper, an American volunteer, is a highly efficient and valuable captain in the squadron. He always takes an interest in his aircraft and the welfare of his crew, and on all occasions shows the greatest keenness to take part in operations, even on successive nights.

F/O. H. SHAPIRO, R.C.A.F., No. 7 Sqn.—F/O. Shapiro, as navigator, co-ordinates his work with his wireless operator, captain and bomb-aimer with great success, and as a result on many occasions has returned with excellent photographs of the target.

DISTINGUISHED FLYING MEDAL

Flt. Sgt. (now P/O) A. A. BISHOP, R.C.A.F., No. 7 Sqn.—Flt. Sgt. Bishop, a captain of an aircraft, has attacked the majority of the heavily defended industrial targets in Germany.

Flt. Sgt. F. G. DAGG, R.C.A.F., No. 106 Sqn.—Flt. Sgt. Dagg has taken part in operational sorties on the most heavily defended areas in Germany. He has never missed the opportunity of attacking gun posts and searchlights, and on several occasions, in combats with enemy fighters his unfailing alertness and accurate shooting have undoubtedly prevented serious attacks developing.

Flt. Sgt. J. D. GADSBY, No. 49 Sqn.—Flt. Sgt. Gadsby, as wireless operator/air gunner, has at all times maintained a high standard of efficiency, displaying courage and coolness in times of difficulty and danger, being unperturbed by anti-aircraft fire, searchlights or night fighters.

Flt. Sgt. G. R. R. GERRY, No. 83 Sqn.—During this airman's long operational career his keenness to engage the enemy has been outstanding and the remarkable standard of his morale beyond all praise. He has attacked very heavily defended areas in Germany, and on many occasions returned home in a badly damaged aircraft, nevertheless the enthusiasm with which he anticipated his next mission has been undiminished and has proved a source of inspiration to his colleagues. On one occasion the aircraft in which he was flying was caught by searchlights and so seriously damaged by anti-aircraft fire as to be almost uncontrollable. Flt. Sgt. Gerry showed magnificent imperturbability, and it was largely due to his coolness and efficiency that the aircraft returned safely to base.

Mining Sortie

Flt. Sgt. W. J. GLENN, No 207 Sqn.—In July, 1942, this N.C.O. was navigator in an aircraft detailed to undertake a mining sortie. Displaying great determination and skill, Flt. Sgt. Glenn brought the aircraft to the target at the correct time and safely back to base, despite adverse weather.

Flt. Sgt. R. B. HOWE, R.A.F.V.R., No. 214 (F.M.S.) Sqn.—Flt. Sgt. Howe has attacked targets at Berlin, Hamburg and Turin. On several occasions his aircraft has been severely damaged, twice members of his crew have been wounded by anti-aircraft fire. Recently this Flight Sergeant

was serving as mid-upper gunner in an aircraft which was repeatedly attacked by a Me 110. The rear turret was rendered unserviceable and one of his guns was shot away, nevertheless Flt. Sgt Howe continued firing, scoring a hit before the hostile aircraft was lost to view.

Flt. Sgt. H. KITTO, No. 83 Sqn.—This airman has completed many operational sorties as wireless operator, nearly all of which have been on heavily defended targets in Germany and two particularly hazardous attacks in daylight on Danzig and Essen. Flt. Sgt. Kitto has been in many perilous situations and in September, 1942, was very seriously wounded by machine-gun fire.

Flt. Sgt. I. A. H. LINKLATER, No. 207 Sqn.—Flt. Sgt. Linklater has a long record of operational duty and has at all times been an exceedingly capable and efficient wireless operator and a valuable member of his crew. On one occasion when detailed to attack Berlin, before reaching the target area, the aircraft was attacked by two hostile aircraft. Flt. Sgt. Linklater, displaying outstanding coolness and presence of mind, gave such valuable assistance to the pilot and gunners that one of the Me 110s was shot down and the other seriously damaged. Largely due to his perseverance and courage, under most difficult conditions during the return journey, his severely damaged aircraft was able to return safely to base.

Flt. Sgt. D. M. MACDONALD, R.C.A.F., No. 103 Sqn.—Flt. Sgt. MacDonald, serving as first wireless operator, has participated in a number of operational sorties. On one occasion when attacking Essen by night, his aircraft was severely damaged by anti-aircraft fire and the wireless was rendered unserviceable. Showing great presence of mind and resourcefulness he effected a repair with chewing gum.

Flt. Sgt. W. T. L. MERRICK, R.C.A.F., No. 106 Sqn.—As air-gunner Flt. Sgt. Merrick has taken part in numerous operational sorties and has destroyed two enemy night fighters. In July, 1942, whilst on a bombing sortie over Saarbruecken his aircraft was attacked by enemy fighters on five separate occasions, and it was mainly due to his accuracy and coolness that two hostile aircraft were driven off and another shot down.

Flt. Sgt. J. D. ROBINSON, No. 207 Sqn.—Flt. Sgt. Robinson, as air-gunner, has operated his guns with great skill, scoring successful hits on anti-aircraft guns and searchlights.

Dousing the Glim

Flt. Sgt. J. G. STEELE, R.A.A.F., No. 218 (Gold Coast) Sqn.—Flt. Sgt. Steele is a determined and efficient air-gunner. On one occasion whilst mine laying his aircraft was caught and held by two searchlights and subjected to intense anti-aircraft fire. Displaying skilful shooting this air-gunner put both searchlights out of action and a few minutes later he succeeded in extinguishing a third. On another occasion, during a daylight attack, Flt. Sgt. Steele's aircraft was attacked by three Me 109s. Three of his guns were put out of action. He continued to fire his remaining gun, repaired those damaged, and, meanwhile, gave an excellent running commentary on the attack, which enabled his pilot to take successful evasive action.

Flt. Sgt. A. WALTERS, No. 207 Sqn.—Flt. Sgt. Walters has proved himself to be a captain with outstanding qualities of courage, determination and coolness in the face of the enemy. He has with great determination pressed home his attacks on many of the most heavily defended targets in Germany.

Sgt. C. W. WOODS, R.A.A.F., No. 214 (F.M.S.) Sqn.—This captain of aircraft has completed many operational sorties, including two to Hamburg, five to Bremen, and eight to the Ruhr. One night in September, 1942, he was detailed to attack a target in Munich. Despite intense searchlight activity and anti-aircraft fire, he forced home his attack. On another occasion he was detailed to lay mines off the enemy's coast. After taking off, his undercarriage failed to retract. Showing great determination, Sgt. Woods proceeded and successfully laid the mines, and on returning to base skilfully landed without injury to his crew.

Sgt. J. K. CALLISTER, R.N.Z.A.F., No. 214 (F.M.S.) Sqn.—This N.C.O. has a long and varied record of operational duty, both in the western theatre of war and the Middle East. He has

SERVICE AVIATION

attacked targets in Germany, Libya, Greece and Crete. Despite two crashes, Sgt. Callister is an exceptionally keen air-gunner, always calm and steady in the air, and is a most valuable member of any crew.

Sgt. R. S CARR, No. 207 Sqn.—Sgt. Carr's record is one of exceptional keenness and efficiency, and his discipline both on the ground and in the air has been outstandingly good. One night towards the end of June, 1942, he was rear gunner in an aircraft detailed to attack Bremen. Shortly after crossing the enemy coast the aircraft was attacked by a Ju 88. It was primarily due to the concise and accurate guidance given by this sergeant that the pilot was able to take evasive action, thus enabling the aircraft to proceed on its mission successfully and return safely to base.

Iced Up : On Fire

Sgt. G. E. COWEN, No. 149 Sqn.—In September, 1942, when returning from the Rhineland, Sgt. Cowen's aircraft was attacked by an enemy fighter and badly damaged. Displaying great coolness he successfully extinguished two small fires. The weather was hazardous and the bomber badly iced up. Throughout this perilous trip this N.C.O., by his unfailing cheerfulness and efficiency, largely contributed to the safe return of the aircraft to base.

Sgt. W. K. HYNAM, No. 103 Sqn.—Sgt. Hynam is an imperturbable and reliable N.C.O. who has served respectively as wireless operator, front gunner and bomb-aimer.

Sgt. P. S. ISAACSON, R.A.A.F., No. 460 (R.A.A.F.) Sqn.—This captain of aircraft has taken part in many successful night attacks, showing a fine offensive spirit and great determination. Sgt. Isaacson is an ideal leader who, by his courage, skilful pilotage and cool judgment, holds the complete confidence of his crews.

Sgt. D. A. JORDAN, No. 106 Sqn.—Sgt. Jordan throughout the winter of 1940-41 participated in many long raids as air-gunner. In December, 1941, he was detailed to attack a target at Emmerich in daylight. He machine-gunned the target from 300 feet. Subsequently this N.C.O. was wireless operator and in this capacity took part in the majority of the heavy raids on the enemy's most strongly defended territory.

Sgt. W. C. NORRINGTON, No. 115 Sqn.—Sgt. Norrington has participated in many operational sorties, some of which have been as captain of aircraft. He has been largely responsible for many excellent photographs.

Sgt. E. V. SIMPSON, No. 61 Sqn.—Throughout his operations Sgt. Simpson has served as wireless operator/air-gunner and has participated in some outstandingly successful raids.

Sgt. R. W. J. SMITH, R.A.A.F., No. 50 Sqn.—Sgt. Smith is an air-gunner of outstanding personality. With a calculating courage he has always shown a complete disregard of danger in his determination to place his bombs on the target. He has taken part in many successful sorties, at times despite poor visibility and intense enemy opposition. One night in August he took part in a mission calling for a high standard of navigation and achieved complete success.

Sgt J. L. YOUNG, No. 207 Sqn.—In May this airman was the wireless operator of an aircraft detailed to lay mines. On the outward journey one engine failed, and whilst over the target area the aircraft was hit by anti-aircraft fire, the compass being seriously damaged. On the return journey the aircraft was again hit by anti-aircraft fire and a second engine damaged. Largely by the cool determination and great skill displayed by Sgt. Young the aircraft was brought back to base with its mission successfully achieved.

The King has been graciously pleased to approve the following award :—

For gallantry and resolution when H.M. Air/Sea Rescue Craft were heavily attacked by enemy aircraft in the Straits of Dover :

DISTINGUISHED SERVICE MEDAL.

A/C.1 S. G. WHITLOCK, R.A.F.

A SMART TURN-OUT : The band at one of the W.A.A.F. training centres.

Roll of Honour

Casualty Communiqué No. 178.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Royal Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. C. H. Atkinson; Sgt. F. G. Cross; Flt. Sgt. M. C. Daniell; A/C.1 J. E. Gardiner; Cpl. C. Hacker; Sgt. E. J. Hartley; Sgt. J. B. Jones; Act. Flt. Lt. G. J. Norton; F/O. J. E. Ramshaw; Sgt. D. E. Round; Sgt. E. Talbot.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. S. R. Baker; Sgt. J. H. H. Baness; Sgt. T. Birtwhistle; Sgt. J. Canavan; Sgt. R. Hillman; P/O. J. T. W. Kelly; Sgt. D. H. Phillips; Wing Cdr. G. F. Simond; Act. Flt. Lt. D. F. Walker; Sgt. W. V. Walters; Act. F/O. H. Wathey, D.F.M.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. W. P. C. Bennett; A/C.1 A. L. Sneath; Cpl. H. Wray.

WOUNDED OR INJURED IN ACTION.—Sgt. H. V. Adams; P/O. E. Armitage; Sgt. E. M. Rogers.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—P/O. A. E. Scott.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. J. A. Adamson; Sgt. W. S. Allen; P/O. H. Astell-Burt; Act. Sqn. Ldr. A. E. Berry, D.F.C.; Sgt. J. Bingham; Flt. Sgt. B. S. Blundell; P/O. E. A. R. Briant; P/O. T. D. Brown; Sgt. E. F. Burrell; Sgt. G. Carroll; Sgt. E. W. J. Chaldecott; Act. Gp. Capt. W. M. Churchill, D.S.O., D.F.C.; Sgt. R. M. Clark; Sgt. J. D. Craig; Sgt. T. Douglas; Sgt. G. W. Draper; Sgt. W. Duncombe; Sgt. F. C. Easterling; Sgt. E. C. Evans; Sgt. W. G. Foale; Act. Flt. Lt. J. R. Frith; Sgt. E. N. Galloway; P/O. F. E. Gardiner; P/O. D. Gill; Flt. Sgt. W. Graham; Sgt. I. B. Griffiths; Sgt. E. Hepworth; P/O. P. G. Hopkins; F/O. D. A. Kingston; Sgt. G. D. Leslie; Flt. Sgt. D. E. Morgan; Sgt. J. D. Parkinson; P/O. D. P. Pollock; Sgt. A. E. Rees; Sgt. W. P. Ryan; P/O. C. P. Shaw; P/O. W. R. Simpson; F/O. W. A. Skelton; Sgt. J. W. Street; Sgt. P. G. H. Strudwick; Sgt. H. C. Taylor; Flt. Sgt. J. R. Wanbon, D.F.M.; Sgt. N. S. Wilding; Sgt. G. H. Wilson.

MISSING.—Flt. Sgt. E. K. A. Anderson, D.F.M.; Sgt. I. F. L. Arthur; Sgt. W. G. Bate; Sgt. T. Barker; Sgt. J. C. Bennett; Flt. Lt. G. R. Bennette; Flt. Sgt. L. Blashill; Sgt. G. Bonnar; Flt. Lt. E. H. Brown; Sgt. W. Brown; Sgt. W. Bulman; Sgt. A. E. Burkitt; Sgt. M. H. Burtt; P/O. E. E. T. Cattermull; Flt. Lt. W. A. H. Chapman; Sgt. S. Clare; Sgt. W. E. Collins; Sgt. A. M. Craig; Sgt. N. Crutchley; P/O. R. M. Cundy; Sgt. H. R. Davies; Sgt. J. D. Dickie; Sgt. W. H. Fardoe; Sgt. H. Firth; P/O. J. W. Frazer; Sgt. H. Gregg; P/O. A. W. Groves; P/O. K. F. Harding; Sgt. W. L. Harper; Sgt. F. A. Hayes; Sgt. C. A. Holmes; Sgt. W. R. Hopkins; Sgt. H. L. Jewell; Flt. Sgt. S. F. Kane; P/O. H. J. Kendrick; Sgt. R. G. A. Lee; Sgt. J. McArthur; P/O. G. McAuley; Sgt. A. G. G. McBain; P/O. G. W. MacAllister; Sgt. P. McCann; Cpl. A. H. MacDonald; Sgt. J. D. R. MacGillivray; Sgt. A. H. McKenzie; Sgt. J. L. MacLachlan; P/O. J. A. McLean; Sgt. W. B. McVicar; Sgt. E. W. Margetts; P/O. A. Maxwell; Sgt. E. Mitchell; P/O. H. R. Nash; Sgt. G. L. A. Neale; Sgt. E. Nettleton; Sgt. P. Oaten; Sgt. J. W. Platt; Sgt. J. Preston; Sgt. C. Racine; Sgt. T. A. Reid; P/O. H. C. Reynolds; Sgt. R. D. Rick; Sgt. A. Riding; Sgt. B. W. Roberts; Sgt. R. Robson; Sgt. A. Rodam; P/O. A. J. Southwell; Flt. Sgt. J. A. Sparks; Sgt. S. Spencer; P/O. G. L. Staniar; Sgt. G. Stead; Sgt. A. L. Steel; Sgt. S. E. Stevens; Sgt. R. D. Stevenson; P/O. J. K. Stewart; Sgt. H. C. Stubbs; Sgt. F. C. G. Tate; P/O. J. R. Thornton; Sgt. N. Tomlin; Sgt. S. Topham; Sgt. K. H. Watson; Sgt. J. H. Webb; Sgt. J. H. Westgate; Sgt. R. C. M. White; Sgt. D. H. Whiting; Sgt. E. S. C. Williams; Flt. Sgt. J. A. Williams; Sgt. R. V. Willshire; Sgt. W. P. L. Wood.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—L.A/C. G. K. Hamilton; Sgt. L. Hargrave; Sgt. A. J. P. Howe; Sgt. R. M. Jack; Sgt. R. Pontin; P/O. I. G. T. Roberts.

KILLED ON ACTIVE SERVICE.—Sgt. W. Bottomley; Sgt. J. Brown; Sqn. Ldr. W. J. Carr, A.F.C.; Sgt. P. T. Cunningham; L.A/C. T. H. Fox; L.A/C. C. G. Keslake; Sgt. B. T. Lamb; Sgt. S. McD. Wilson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—P/O. R. T. Franklin; Sgt. L. R. Palmer.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. G. Dixon; Act. Sgt. R. H. L. House; Cpl. M. W. Johnson; A/C.1 A. R. Moloney; P/O. J. O. H. Norton; L.A/C. E. G. Parsons; P/O. J. W. A. Posnett; Sgt. J. G. Ross.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Cpl. S. W. Butland; Sgt. A. F. Hendriksen; Sgt. G. D. Jones; L.A/C. R. J. Moss; Sgt. K. A. Wilson.

PREVIOUSLY REPORTED WOUNDED OR INJURED ON ACTIVE SERVICE, NOW REPORTED DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. E. W. E. Jones.

DIED ON ACTIVE SERVICE.—A/C.2 D. C. Bevan; Flt. Lt. A. E. Dark; A/C.2 H. Edley; L.A/C. E. Evans; L.A/C. L. Jackson; A/C.1 J. R. Livesey; A/C.1 J. F. Mitchell; A/C.2 C. W. Morgan;

SERVICE AVIATION

A/C.1 W. E. Morgan; L.A/C. M. J. O'Brian; A/C.1 R. O. Syme; L.A/C. J. D. Wawn.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. E. B. Bristowe; Cpl. D. J. Crossley; Flt. Sgt. S. C. Emerick; Sqn. Ldr. A. N. Pirie.

Royal Australian Air Force

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. K. L. Blackham.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. F. E. Channon.

MISSING.—P/O. J. E. Coates; F/O. G. W. Downe; P/O. W. M. Edmonds; Sgt. G. Rees-Jones; Sgt. A. J. Pankhurst.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE.—Sgt. K. J. Chandler.

KILLED ON ACTIVE SERVICE.—P/O. I. D. Colquoun-Thompson.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. D. Scott.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. D. S. Aitken.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—P/O. L. R. Maguire.

WOUNDED OR INJURED IN ACTION.—Flt. Sgt. J. T. Hunt; Flt. Lt. I. G. S. Keltie.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. R. A. Clement; Sgt. N. Grattan; Sgt. W. J. Hesp; Sgt. W. H. Irvine; Flt. Sgt. J. A. McLean; Sgt. J. R. F. Soutar; Sgt. J. F. Tuck.

MISSING.—Sgt. R. J. Blenkarn; Flt. Sgt. B. A. Brophy; Flt. Lt. J. S. Cardell; Flt. Sgt. J. J. Carey; Sgt. H. A. Chislett; Sgt. J. C. Colter; Sgt. J. D. O'L. Cooney; Sgt. A. B. Craig; Sgt. R. N. A. Creswell; Flt. Sgt. J. W. Hutchinson; P/O. M. L. McCarthy; Sgt. A. I. McDonogh; Sgt. R. P. McLaren; P/O. D. S. MacLean; P/O. D. S. Maaur; P/O. V. M. Morrison; P/O. D. J. Quinlan; Sgt. A. H. Robitaille; Sgt. R. C. Stuart.

Royal New Zealand Air Force

MISSING, BELIEVED KILLED IN ACTION.—Sgt. J. A. MacPherson.

MISSING.—P/O K. H. Alderton; F/O. J. E. S. Bentley; P/O. H. R. Blake, D.F.C.; F/O. D. V. Bullock; P/O. V. D. James; Sgt. C. C. Newlove; Sgt. E. Perks; Flt. Sgt. N. J. Sutherland; Sgt. H. J. Wakeman; F/O. A. G. B. Williams; Sgt. J. O. Williams.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. C. W. Andrews.

Casualty Communiqué No. 179.

Royal Air Force

KILLED IN ACTION.—Sgt. J. Bryce; Sgt. B. Corran; Flt. Sgt. J. D. Cunningham; Sgt. F. Fowler; P/O. A. H. Friday; Sgt. P. Hayes; Sgt. B. B. Jackson; Sgt. A. W. Jones; Sgt. G. J. V. Lock; P/O. N. R. MacQueen; P/O. W. McD. Menzies; Sgt. J. F. J. Montgomery; P/O. G. J. Nicholson; Sgt. H. E. Owens; P/O. F. Rogers; Sgt. J. B. Williams; Sgt. W. E. Wilson; F/O. R. F. Wollaston; Flt. Sgt. J. M. Wootton.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. C. J. Rowley.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—F/O. S. Birch; Sgt. I. T. James; P/O. I. A. B. Johnstone; P/O. A. J. Jones; Sgt. D. MacMillan; P/O. J. A. W. Sandy; P/O. J. B. Scarr; Sgt. J. A. Sellars; P/O. E. Tunnington; P/O. M. Woodhouse.

WOUNDED OR INJURED IN ACTION.—P/O. S. Moth; Flt. Lt. A. P. V. Strachan; Sgt. P. G. C. Thomas.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. G. Bolton; Sgt. A. S. Funnell.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. C. H. Brummitt; Flt. Sgt. W. Carmichael; Flt. Sgt. J. H. Coxon; Sgt. J. W. Cook; Sgt. H. J. Endley; P/O. W. A. Fullerton, D.F.M.; Sgt. V. A. Hamon; Sgt. W. J. Justice; Flt. Sgt. D. H. Methven; Sgt. J. L. Morris; Sqn. Ldr. D. D. Pryde, D.F.C.; Sgt. B. Quinn; Sgt. J. Skipsey; Sgt. W. E. Spooner; Sgt. E. S. Thomas; Sgt. W. L. E. Traquair; F/O. R. Weston.

MISSING.—Flt. Sgt. H. Asquith; Sgt. E. Barr; Sgt. L. E. Billings; Sgt. C. Black; Sgt. A. S. Boyd; Sgt. G. K. Brown; F/O. J. S. Bunbury; Sgt. H. R. Bushell; Sgt. A. Byron; Sgt. M. P. Gallagher; Sgt. P. W. Carruthers; Sgt. R. A. Cherrington; Sgt. F. P. Coaker; Sgt. R. S. Cruise; Sgt. G. Cunningham; P/O. F. R. E. Davies; P/O. W. Davies; Flt. Sg. S. B. T. Davis; Sgt. F. G. Drewry; Sgt. H. C. Finch; P/O. W. R. Foxlee; Sgt. L. D. Graves; Sgt. D. E. Gwynn; Sgt. C. W. Hancock; Sgt. E. W. Hargreaves; Sgt. R. J. Harris; P/O. R. G. D. Jaggard; Sgt. C. F. James; Sgt. L. G. Jones; Sgt. H. J. Loveday; Sgt. A. McNeil; Sgt. J. W. Merifield; Sgt A. McD. Milne; P/O. D. W. E. Morgan; Sgt. A. Morris; Sgt. W. Osselton; Sgt. B. Palmer; Sgt. G. Phillips; P/O. T. R. Prescott; Sgt. A. F. Priest; Sgt. L. G. Rees; Cpl. J. Rice; Sgt. R. L. S Ritchie; P/O. D. W. Rowe; Sgt. J. A. Sharp; Sgt. P. Simpson; Sgt. C. P. Smith; P/O. W. G. Storrier; Sgt. C. H. Vickers; Sgt. P. E. Watkins; Sgt. S. T. White; P/O. C. L. Woodland.

KILLED ON ACTIVE SERVICE.—P/O. L. I. Alter; L.A/C. K. Barron; F/O. J Birkbeck; Sgt. A. Bradshaw; Sgt. G. S. Catto; Sgt. J. F. Collins; Sgt. G. F. H. Couch; Flt. Lt. R. F. Crockett; Sgt. F. S. Diplock; P/O. E. Dove; Sgt. R. F. Ellis; Sgt. B. J. Foster; L.A/C. G. Frith; Sgt. J. D. Frost; Sgt. L. M. A. Green; Sgt. F. J. B. Griffin; P/O. P. Gruchy; Flt. Lt. P. S. A. Hillier, D.F.C.; W/O. S. J. Johnson; W/O. H. Jones; Sgt. D. D. Knott; Sgt. K. Letch; Sgt. R. J. F. Lunn; Sgt J. McSherry; Cpl. F. J. Milne; Sgt. D. L. Nicholas; Sgt. J. W. Perry; Sgt. F. Pettit; P/O. F. Ratcliffe; Sgt. T. V. Robinson; L.A/C. V. F. Rodger; Sgt. A. F. Rooke; L.A/C. E. R. J. Spooner; Sgt. H. Stone; Sgt. L. S. C. Tait; Sgt. J. H. Thomas; F/O. W. Thornley; Sgt. W. Whalley; Sgt. F. Whyte; Sgt. J. E. Wilkinson; Sgt. D. Wilson; P/O. P. G. Wilson; L.A/C. F. D. Young.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED ON ACTIVE SERVICE.—Sgt. L. D. Traylen; Sgt. S. J. Wilson.

WOUNDED OR INJURED ON ACTIVE SERVICE.—L.A/C. E. Barnes; Cpl. R. W. T. Custard; Flt. Sgt. L. A. Goodson; A/C.2 A. K. Richards; L.A/C. P. W. White; Cpl. J. W. Winskill.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/C. A. Bretter; Flt. Sgt. S. M. Cooksey; Flt. Sgt. W. H. Drury; L.A/C. M. J. Summers.

DIED ON ACTIVE SERVICE.—Cpl. C. G. H. K. Dutton; L.A/C. G. W. Ellis; A/C.1 L. F. J. G. Pearce; Sgt. F. S. Smith.

PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.—Sgt. G. Horn; Flt. Sgt. J. R. Stein.

Women's Auxiliary Air Force

KILLED ON ACTIVE SERVICE.—Assist. S/O. M. R. Hussey.

DIED ON ACTIVE SERVICE.—A/CW.1 W. V. Sweet.

Royal Australian Air Force

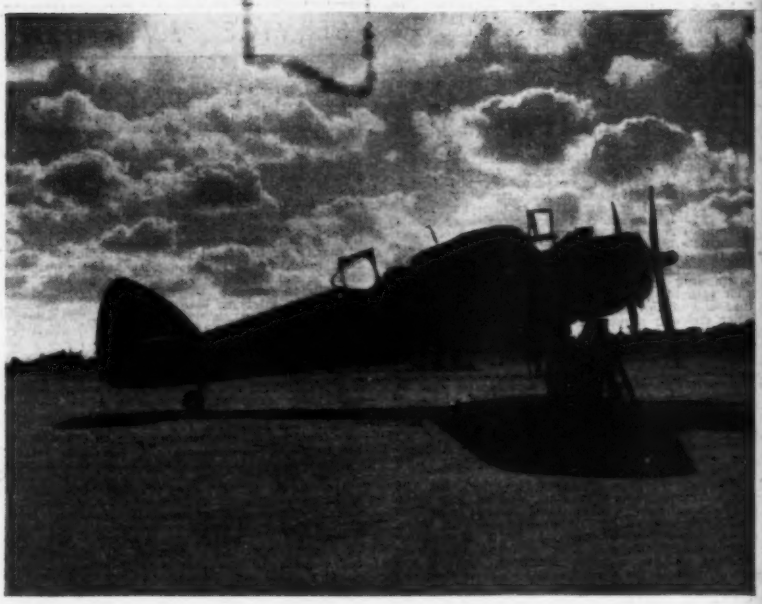
KILLED IN ACTION.—P/O. E. R. Barnfather; Sgt. A. R. Duncanson; Sgt. A. C. Dyte; Sgt. R. J. Evans; Sgt. M. T. Goldsworthy; Sgt P. D. Martin; Sgt. R. D. Walker.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. J. H. Dinning; Sgt. C. H. Muir

MISSING.—Sgt. R. S. Brandon; Sgt. W. R. S. Cornish; Sgt. A. J. Henry; Sgt. G. R. Knapp; F/O. A. G. MacDonald; Sgt. A. M. T. Mears; Sgt. H. G. Neville; Flt. Sgt. C. H. Pierson; Sgt. W. N. Smith; Sgt. W. E. Somerville; F/O. K. Terry; Sgt. G. P. Windsor.

KILLED ON ACTIVE SERVICE.—Sgt. A. G. H. Arnott; Sgt. R. D. Adamson; Act. Flt. Lt. A. F. Howell; Sgt. B. W. Jenkins.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Sgt. A. M. Goldsmith; P/O. A. G. Richmond.



IN SILHOUETTE : A Bristol Beaufighter at its dispersal point being prepared for the night's work.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. R. A. Armstrong; Sgt. L. Kriger; Sgt. J. J. Lucas.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. J. W. Stirling; Sgt. E. Thomas.

MISSING, BELIEVED KILLED IN ACTION.—Flt. Sgt. E. H. Brown; Sgt. T. McBride.

MISSING.—Sgt. H. D. Baittie; P/O. R. J. Corrigan; Sgt. L. D. Dawdy; P/O. J. K. Ferguson; Sgt. M. E. Greer; Sgt. L. D. Hiltz; Sgt. W. R. C. Johnston; Sgt. D. A. McKay; Flt. Sgt. R. H. Morgan; Sgt W. Peebles; P/O. C. E. Smith; F/O. E. D. Van Ier; Sgt. R. B. Walls.

KILLED ON ACTIVE SERVICE.—Sgt. F. N. Andrew; Sgt. D. E. Brownlea; Sgt. N. A. Clare; Sgt. C. G. Eagles; Sgt. L. O. Glay; Sgt. T. H. Grasswick; Sgt. G. A. Gray; Sgt. W. J. Hisson; Sgt. J. K. Johnston; Sgt. J. W. Leyland; Sgt. N. A. MacKenzie; Sgt. J. O. McLean; Flt. Sgt. N. MacPherson; Sgt. J. G. Newman; Sgt. P. V. Norris; Sgt. J. E. G. R. Paltry; Sgt. R. J. Pollock; Sgt. A. M. Rowe; Sgt. J. J. P. Wardrop.

WOUNDED OR INJURED ON ACTIVE SERVICE.—F/O. S. R. H. Dunfield; Sgt. K. R. Fisher; Sgt. B. M. Tripp.

DIED ON ACTIVE SERVICE.—P/O. J. McLaren.

Royal New Zealand Air Force

MISSING, BELIEVED KILLED IN ACTION.—Sgt. A. W. O'Dowd.

MISSING.—Sgt. L. G. Knight; P/O. G. E. Murdoch.

KILLED ON ACTIVE SERVICE.—P/O. N. G. Bailey; P/O. L. P. Booker; Sgt. A. A. Haydon; W/O. J. E. Jones; Sgt. E. W. MacLaren.

South African Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Lt. J. D. K. Thomas.

WOUNDED OR INJURED IN ACTION.—Lt. D. G. Bailey; Major A. C. R. Metelerkamp.

MISSING, BELIEVED KILLED IN ACTION.—Lt. N. B. Boyd; Lt. L. A. Carnovski; Air Sgt. F. Olivier.

MISSING.—Lt. W. H. O. Brown; Lt. H. E. Ironside; Lt. A. Morrison.

OFFICIAL AMENDMENT TO CASUALTY COMMUNIQUE No. 161.

Under the Heading "KILLED IN ACTION.

For P/O. R. Clark read P/O. K. Clark.